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USING A COUNTERFACTUAL PROCESS TO IDENTIFY THE APPLICABILITY OF EMERGING TECHNOLOGY

by

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Law enforcement is often ill-prepared to identify and adopt emerging technologies into its agencies and communities. This ineffectiveness frequently leads to unintended consequences, as well as a technological gap between police departments and the criminal elements. This thesis examines how counterfactual analysis might assist law enforcement organizations to successfully implement emerging technologies into society. A counterfactual thought experiment was conducted using a historical event in which the applicability of an emerging technology (or antecedent) was analyzed. The antecedent for this scenario was Augmented Reality technology, in the possession of law enforcement personnel during the Boston Marathon Bombing that occurred on April 15, 2013. This thesis found that counterfactual analyses could allow agencies to assess the value of emerging technologies by considering their hypothetical use in past incidents and determining applicability in the future. Adopting this process might assist law enforcement in becoming more efficient in acquiring and implementing new technologies into its communities.

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USING A COUNTERFACTUAL PROCESS TO IDENTIFY THE APPLICABILITY OF EMERGING TECHNOLOGY

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Submitted in partial fulfillment of the
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ABSTRACT

Law enforcement is often ill-prepared to identify and adopt emerging technologies into its agencies and communities. This ineffectiveness frequently leads to unintended consequences, as well as a technological gap between police departments and the criminal elements. This thesis examines how counterfactual analysis might assist law enforcement organizations to successfully implement emerging technologies into society. A counterfactual thought experiment was conducted using a historical event in which the applicability of an emerging technology (or antecedent) was analyzed. The antecedent for this scenario was Augmented Reality technology, in the possession of law enforcement personnel during the Boston Marathon Bombing that occurred on April 15, 2013. This thesis found that counterfactual analyses could allow agencies to assess the value of emerging technologies by considering their hypothetical use in past incidents and determining applicability in the future. Adopting this process might assist law enforcement in becoming more efficient in acquiring and implementing new technologies into its communities.

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EXECUTIVE SUMMARY

The rapid pace of technological advances often leaves law enforcement unprepared and ill-equipped to successfully use them. The inability to detect potential threats in the future and to assess their impacts could prove disastrous for police organizations and the communities they protect. The U.S. law enforcement community frequently faces new challenges and threats as the criminal element becomes more technologically savvy. As technology provides new avenues for criminals to exploit society, it is imperative law enforcement organizations look beyond the offenses that currently exist and recognize future technologies that may prevent the effects of future crimes. Police often look to technologies to assist them in completing their missions but do not recognize the issues they may cause for their communities. Success in the field depends on recognizing the impact technologies may have outside of a laboratory. Counterfactuals could provide a method for police agencies to identify the applicability of emerging technologies in law enforcement applications.

Counterfactual analyses may allow police departments to assess the value of new technologies by considering their hypothetical use in past incidents and determining applicability in the future. This process may assist law enforcement in detecting potential liabilities, civil rights concerns, and other challenges presented by a particular technology. Using counterfactual thought experiments is valuable because it provides a better system of analysis without having real world consequences. Police organizations can use counterfactual analyses to mentally test technologies and identify those that best fit their mission. Augmented Reality is one technology that has the potential to increase the capabilities of police organizations in the future.

This thesis constructed a counterfactual thought experiment to identify the applicability of Augmented Reality. The scenario consisted of an antecedent, Augmented Reality headgear, and a historical event, the 117th Boston Marathon bombing. The incident was rerun with all law enforcement personnel wearing Augmented Reality headgear to determine the potential impacts the technology could have had on the police response.

An analysis conducted of the counterfactual scenario identified several instances where the use of Augmented Reality headgear might have changed the outcomes of the incident. For example, had the technology identified Dzhokhar and Tamerlan Tsarnaev sooner, then some of the events that unfold later in the week may have been prevented. The analysis also found, the use Augmented Reality headgear could have improved situational awareness, command and control, as well as officer safety. Additionally, the technology could have allowed law enforcement to gather much more data, which might have assisted it during the investigation. Overall, Augmented Reality headgear might have improved the law enforcement response to the 117th Boston Marathon bombing.

Although this technology could have potentially altered some of the subsequent events that took place after the initial bombing, it is questionable it could have prevented the bombing altogether. However, this scenario also recognized several areas of concern. As with any counterfactual thought experiment, there are many factors that could have influenced the outcome of an incident. This is especially true in dynamic situations where human emotions are involved. Therefore, it is impossible to say with complete certainty that things would have happened the way they were presented. Technologies like Augmented Reality headgear often rely on communication systems, databases, and Internet connectivity to function properly. It is important to realize, in large-scale incidents, some of these capabilities could fail.

A counterfactual analysis is an inexpensive and efficient method to identify applicable technology as well as the issues that often hinder agencies in their successful adoption. Conducting counterfactual thought experiments allows police agencies to identify both the positive impacts a technology might have on their communities as well as the potential issues they might bring. This process provides an opportunity for law enforcement agencies to systematically identify the potential risks and benefits of emerging technologies by examining their use in past incidents. History often repeats itself, so using past incidents as future indicators provides a solid foundation to conduct counterfactuals. Furthermore, this process provides a sequence of events that control how the technology could be implemented into the event. The historical incident provides fixed variables based on the real event, which provides a structure to test the technology.

It also shows how decisions could create a ripple effect within the incident and could have changed outcomes that could not be imagined in fictional incidents. Once the thought experiment has been concluded, it provides a basis for analysis and recommendations, thus, adding credibility to the process.

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I. INTRODUCTION

A. RESEARCH QUESTIONS

How effective is a counterfactual analysis in testing Augmented Reality for the law enforcement community? How can a counterfactual analysis determine the applicability of other emerging technologies?

B. PROBLEM STATEMENT

The U.S. law enforcement community frequently faces new challenges and threats as the criminal element evolves in an effort to elude apprehension. Over the last three decades, in almost every facet of law enforcement, there have been tremendous innovations in technology.[1] Due to decreased budgets and reduced manpower, law enforcement organizations are turning to technologically advanced equipment, rather than personnel, in an effort to become more efficient in fighting crime.[2] Law enforcement agencies that implement new technologies can prevent crimes more efficiently and solve crimes more quickly.[3]

This rapid pace of technological advances often leaves police organizations unprepared and ill-equipped to successfully use them. The inability to keep up with these innovations can often be costly and ineffective for police agencies.[4] Unfortunately, agencies that do not have the necessary resources to avert constantly changing threats often lack the vision or funds to implement technological solutions. Thomas Cowper, Charles Heal, and Andreas Olligschlaeger point out, "Every new technological breakthrough with application to law enforcement, or of use by criminals and terrorists, brings with it new and unique difficulties and dilemmas for the police and their

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[1] Michael Idom, "Developing Less Lethal Weapons for the Future of Law Enforcement," Law Enforcement Command College, 2003, accessed http://lib.post.ca.gov/lib-documents/cc/35-Idom-j.pdf, 1.

[2] Kris Tufto, "Image Sensing Systems Introduces the City Sync Automated License Plate Recognition Solution," Image Sensing Systems, October 31, 2012, http://www.imagesensing.com/company/news-and-events/120918.html.

[3] Ger Daly, "Embracing the Police Force of the Future," *CNN*, September 19, 2013, http://www.cnn.com/2013/09/18/tech/innovation/police-future-technology/

[4] Ibid., 1.

communities."[5] In addition, Cowper, Heal, and Olligschlaeger's point is that as new technologies are introduced into society, law enforcement and the public need to address the issues and complexities that come with them. They go on to explain the challenge of technology adoption: "Every new system or network intended to improve policing can also bring with it unwelcome financial hardship, organizational transformation and public scrutiny to agencies that may not be prepared for them."[6] In making this comment, they are saying law enforcement is often ill prepared to handle the downside that technologies bring to the agencies and their communities.

Recent history suggests police departments wait for the U.S. military or private corporations to design tools and weapons for law enforcement.[7] In addition, the law enforcement community often approaches the U.S. military or the private sector to assist in closing technological gaps or often find itself waiting for either the military or private corporations to design tools and weapons with secondary law enforcement applicability.[8]. Unfortunately, a technology often finds its way to the law enforcement community several years or even decades after it has proven successful in military operations. Because of this and not being at the forefront of developing technology, police departments often find themselves with outdated technology that has not been tested in the domestic environment. This ineffectiveness results from a lack of resources to assist in the identification of emerging technologies and determining field applicability. The majority of law enforcement agencies do not employ a process to identify emerging technologies that may assist them in day-to-day operations. Because police are not watching for these technologies until they arrive, departments are not organizationally or operationally prepared to implement them. This lack of preparation by an agency often causes unintended consequences, such as misuse by officers, which can create issues for the organization. These shortcomings often lead to legal issues involving use of force or

[5] Thomas Copwer, Charles Heal, and Andreas Olligschlaeger, "Law Enforcement Technology 2015," in *Homeland Security: 2015 Proceedings of the Futures Working Group*, vol. 2, ed. Michael Buerger (Washington, DC, Federal Bureau of Investigation, 2006), http://futuresworkinggroup.cos.ucf.edu/docs/Volume%202/FWG%20Homeland_Security_2015.pdf, 29.

[6] Ibid., 29.

[7] Ibid., 5.

[8] Idom, "Developing Less Lethal Weapons," 1.

civil rights violations, which may diminish the effectiveness of the technology as well as public support. If the law enforcement community were to formulate a process to recognize emerging technologies, it may have an opportunity to validate the deficiencies of a technology prior to implementation, allowing it to acquire new technologies more effectively.

Law enforcement agencies do not require expensive research facilities, additional personnel, or complex equipment to determine the usefulness of emerging technologies; they simply need to develop a method for identifying the applicability of emerging technology in order to improve operational capabilities. A counterfactual analysis, often called an alternative history, could be an effective method for assessing emerging technologies in law enforcement applications. Professor Richard Ned Lebow states, "Counter-factual experiments vary aspects of the past and analyze how these changes might have affected the course of events."[9] Although they have "uncertain outcomes because we can neither predict the future nor rerun the tape of history to see what might actually happen,"[10] carefully constructed counterfactual thought experiments use a specific style and criteria that might provide an appropriate methodology for the law enforcement community.

Counterfactual analyses may allow agencies to assess the value of emerging technologies by considering their hypothetical use in past incidents and determining applicability in the future. Lebow suggests counterfactuals "are essential teaching tools and critical to establishing claims of causation. They are equally necessary to evaluate real world outcomes."[11] This process may assist law enforcement agencies in identifying potential liabilities, civil rights concerns, and other challenges presented by a particular technology. Once a technology has been vetted through this procedure, an overall assessment of its benefits and liabilities may indicate whether future research is needed.

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[9] Richard Ned Lebow, "Counterfactual Thought Experiments: A Necessary Teaching Tool," *History Teacher* 40, no. 2 (2007), http://www.jstor.org/stable/30036985?origin=JSTOR-pdf, 154.

[10] Ibid., 154.

[11] Ibid., 157.

One technology that has potential to increase the capabilities of law enforcement is Augmented Reality. Augmented Reality is an emerging technology being tested in education, private industry, retail, and the medical field. Augmented Reality may have the greatest potential for revolutionizing law enforcement agencies and their response to criminal activity because it may have the ability to increase their capabilities before, during, and after an incident. The *Merriam-Webster's Collegiate Dictionary* defines Augmented Reality as "an enhanced version of reality created by the use of technology to overlay digital information on an image of something being viewed through a device."[12] Augmented Reality has the potential to provide law enforcement agencies with real time information and thus enable them to perform their duties more efficiently.

One of the greatest challenges law enforcement officers have is the ability to gain situational awareness through a 911 call or dispatched complaint. Police officers who arrive on a scene attempt to make sense of rapidly changing incidents with little or no information about individuals they may confront or premises they may enter. Situational awareness is difficult to obtain because officers do not have access to information needed to safely and successfully resolve issues and protect both the citizens and themselves in the process. Augmented reality may provide officers with real time information during a response to an incident. It could assist them with facial recognition, blueprints to a venue, and information regarding the location of other officers that are on scene or approaching the scene. Augmented reality has the potential to fill these gaps in law enforcement response as well as provide solutions to many other areas of police operations. Augmented reality offers numerous benefits for law enforcement personnel in the areas of command, control, response, investigation, and officer safety. Performing a case study of a historical incident utilizing a counterfactual analysis that focuses on Augmented Reality technology may determine the methods applicability to law enforcement.

The ability to incorporate emerging technologies to protect citizens while preserving their civil liberties is an awesome responsibility that must be upheld under all circumstances. "In an era where scores of Americans have suffered tragedies at the hands

[12] *Merriam-Webster's Collegiate Dictionary*, 11th ed., s.v. "augmented reality."

of rogue gunmen," Lawrence Lopez points out, "we can use technology to mitigate human losses and potentially save lives."[13] The law enforcement community must invest its resources in recognizing emerging technologies and identifying future technologies in order to ensure effective implementation. The use of a counterfactual analysis may assist the identification of applicable law enforcement technologies to ensure successful crime prevention and apprehension of sophisticated criminal elements.

C. LITERATURE REVIEW

This review will analyze relevant literature in the fields of technology adoption and counterfactual analysis to identify potential law enforcement applications. As the law enforcement community lacks effective means of adopting emerging technologies, this section examines literature from various fields to establish a new framework. This section will also explore the counterfactual analysis as a cost-effective approach for testing emerging technologies. Furthermore, it will consider the ramifications of Augmented Reality technology in law enforcement applications. The literature review will be broken down into the following sections: the implementation of law enforcement technology, counterfactual analysis, and Augmented Reality for law enforcement.

1. Implementation of Technology

President of Police Futurist International, Dr. Joseph Schafer, describes the law enforcement culture as one that focuses on the problems of today but rarely examines the future of policing.[14] He discusses the importance of imagining the state of policing in 2020 and the way we arrive at that point.[15] According to Schafer, police leaders need to focus on the preferable future and not just the possible future, so they do not miss the opportunity to shape future police administrations by planting alternative visualizations

[13] Lawrence Lopez, "Drones Will Revolutionize Law Enforcement," *Newsday*, May 16, 2013, http://www.newsday.com/opinion/oped/lopez-drones-will-revolutionize-law-enforcement-1.5277649.

[14] Joseph A. Schafer, ed., *Policing 2020: Exploring the Future of Crime, Communities, and Policing* (Washington, DC: Federal Bureau of Investigation, 2007), http://futuresworkinggroup.cos.ucf.edu/publications/Policing2020.pdf.

[15] Ibid.

today.[16] In his chapter, Thomas Cowper writes about the rapid pace of technological change and how it will impact the policing world in the future.[17] He discusses the importance of understanding the benefits and risks technology will have on the future of policing, but he does not provide a process to adopt emerging technologies. Several other authors within the book discuss the future of police and technology and some of the issues that surround it, but no one provides a methodology to determine the applicability of future technologies.

William Stuart and Michael Idom, graduates of the Law Enforcement Command College, each suggest there are many reasons police departments are unable to rapidly implement technologies.[18] Some of these reasons include deficits in vision, strategy, and funding for procurement. Idom focuses his article on the inability of law enforcement agencies to maintain pace with rapidly changing technologies.[19] He also provides strategic recommendations to become more effective in identifying and adopting less lethal technologies for future use. Stuart's article recommends law enforcement agencies enhance firearms training by using simulated weapons and virtual environments.[20] Additionally, Stuart and Idom both explain how the costs of training and sustainment pose challenges to law enforcement agencies. Moreover, law enforcement communities must consider civil liabilities, legal issues, and public support.

While several forms of new technologies hold promise for enhancing the operation of the nation's approximately 18,000 law enforcement agencies, Christopher Koper, Bruce Kubu, and Bruce Taylor state there is little guidance for these agencies to

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[16] Ibid.

[17] Thomas Cowper, "Information Age Technology and Network Centric Policing," in *Policing 2020: Exploring the Future of Crime, Communities, and Policing*," ed. Joseph Schafer pp. 71–103 (Washington, DC: Federal Bureau of Investigation, 2007), http://futuresworkinggroup.cos.ucf.edu/publications/Policing2020.pdf, 73.

[18] Idom, "Developing Less Lethal Weapons," 42.

[19] Ibid., 1.

[20] William Stuart, "What Role Will Technology Play in the Future of Law Enforcement Firearms Training Facilities? The Future of Realistic Training," Law Enforcement Command College, 2008, http://lib.post.ca.gov/lib-documents/cc/35-Idom-j.pdf.

identify, purchase, and implement them.[21] As a result, police departments are unprepared to proficiently incorporate new technology. Global strategist Marc Goodman argues, "There is little to suggest police will be any more prepared for … emerging threats than they were for basic cyber crimes."[22] In making this comment, Goodman is saying this lack of preparation hinders the ability of law enforcement agencies to successfully adopt new technologies.

Rather than focusing on law enforcement shortcomings, Stephen M. Jarrett asserts the need to identify and transition new technologies into both military and first responder applications.[23] Jarrett discusses the importance of testing technology across multiple fields, advising with the subsequent war on terror all levels of government have been exposed to new technologies both at home and abroad.[24] However, in order to modify these technologies for domestic law enforcement agencies, there must be a theoretical framework established to enable police departments to identify those advancements that would have the greatest positive impact on their agency.

Koper, Kubu, and Taylor recognize the need for incorporating these technologies into various fields, but they do not provide a specific method to implement them. They suggest,

> There has been relatively little scientific study of technology's impact on policing and few carefully controlled before-and-after evaluations of technology implementation. Much of the available evidence, moreover, fails to show that technology has brought about clear and quantifiable improvements in policing.[25]

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[21] Christopher S. Koper, Bruce G. Taylor, Bruce E. Kubu, *Law Enforcement Technology Needs Assessment* (Washington, DC: Police Executive Research Forum and Lockheed Martin Corporation, 2009), http://www.policeforum.org/assets/docs/Free_Online_Documents/Technology/law%20enforcement%20technology%20needs%20assessment%202009.pdf.

[22] Marc Goodman, "How Technology Makes us Vulnerable," *CNN*, July 29, 2012, http://www.cnn.com/2012/07/29/opinion/goodman-ted-crime/index.html.

[23] Stephen M. Jarrett, "Transition of Advanced Technology to Military, Homeland Security, and Law Enforcement Users" In *Defense and Security*, pp. 78–88. In *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, vol. 5403, 9/2004, http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=843363.

[24] Ibid.

[25] Koper, Kubu, Taylor, *Law Enforcement Technology Needs Assessment*, 20.

This lack of evidence may be one of the reasons law enforcement agencies do not take an initiative to adopt some readily available technologies. They further state: "The most systematic information available on technology needs in policing is based on a number of survey and focus group projects that were conducted in the late 1990s and early 2000s."[26] The most prominent of these studies were conducted by The National Institute of Justice (NIJ) in 1997, the Rand Corporation in 2000, a NIJ study in 2000, and an International Association of Chiefs of Police (IACP) in 2005.[27] Koper, Kubu, and Taylor's research indicates that these case studies are out of date and identifies the need for new research.

Stuart and Idom as well as Koper, Kubu, and Taylor all identify funding as a primary issue in adopting emerging technologies. An economic downturn may change what law enforcement services are delivered and how technologies are used to deliver those services.[28] Kris Tufto suggests, "law enforcement organizations are turning to technologically advanced equipment due to smaller budgets and reduced personnel in an effort to become more efficient and help tackle crime."[29] The law enforcement community still needs specialized personnel to test new technologies, just in a more efficient way. Although new technologies may enhance the capabilities of law enforcement agencies, there still must be a balance between manpower and technology. Koper, Kubu, and Taylor suggest, "new technologies will also increase the need for researchers and analysts who can advise police chiefs about which technologies work best in real terms."[30] Basically, Koper, Kubu, and Taylor recommend police agencies have individuals who can provide recommendations as to what technologies will benefit them in accomplishing agency missions. Their research shows a value in having well trained personnel not just new technologies alone.

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[26] Ibid., 26.

[27] Ibid.

[28] U.S. Department of Justice, *Community Oriented Policing Services, The Impact of Economic Downturn on American Police Agencies*, October 2011, http://www.cops.usdoj.gov/files/RIC/Publications/e101113406_Economic%20Impact.pdf.

[29] Tufto, "Image Sensing Systems Introduces the CitySync."

[30] Koper, Kubu, and Taylor, *Law Enforcement Technology Needs Assessment*, 44.

Although much of the literature discusses recognizing and implementing new technology, very little suggests anticipating what is coming 10 or even 20 years from now. Jarrett states, "Most customers don't have the technical expertise nor the visibility of emerging technologies to draft the concepts that would insert advanced technology into their legacy systems."[31] It is this lack of vision that prevents law enforcement jurisdictions from recognizing future technologies useful in solving one or more issues simultaneously. Koper, Kubu, and Taylor suggests, "in the future, the police profession will have a greater need for imaginative thinkers who can create new ways to apply technological devices, or to combine several different types of technology in order to advance a crime fighting purpose."[32] Again, the answer is technology plus creative thinkers.

In their study, Koper, Kubu, and Taylor recognize research as a primary issue being discussed within the law enforcement community.[33] They emphasize that many law enforcement personnel would like to know what technologies are available and how other agencies have overcome issues with the implementation of those technologies.[34] A counterfactual analysis may be an inexpensive and efficient method to identify applicable technology as well as the issues that often hinder agencies in their successful adoption.

Most of the aforementioned sources discuss the rapidly changing technological environment that police agencies face now and in the future. In addition, majority of the authors emphasize the various impacts future technologies will have on police agencies, its officers, criminals, and society. There are many other sources available that examine specific technologies of the future and some of the potential risks and benefits they might bring. However, none discuss a specific methodology to successfully acquire and implement them into society; many simply look at the overall impacts the technologies could have on society such as privacy and civil liberties concerns.

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[31] Jarrett, "Transition of Advanced Technology," 82.

[32] Koper, Kubu, and Taylor, *Law Enforcement Technology Needs Assessment*, 44.

[33] Ibid.

[34] Police Executive Research Forum, *How Are Innovations in Technology Transforming Policing?*, Critical Issues in Policing Series, 2012, National Criminal Justice Reference Service, https://www.ncjrs.gov/App/Publications/abstract.aspx?ID=264621.

2. Counterfactual Analysis

Prominent logicians Dr. Philip E. Tetlock and Dr. Aaron Belkin suggest there are five ways to construct counterfactuals and six main criteria upon which to identify counterfactuals as plausible or implausible.[35] They write that there needs to be a balance when conducting counterfactual experiments to ensure they are not merely arguments of fiction, nor full of bias and errors.

The research of Tetlock and Belkin suggests that in order to conduct a meaningful case study, certain guidelines must be established to ensure plausibility. The six criteria used to evaluate counterfactual arguments are: clarity, cotenability, historical consistency, theoretical consistency, statistical consistency, and projectability.[36] Additionally, Tetlock and Belkin identify clarity and logical consistency or cotenability as the minimal requirements for any of the five styles discussed.[37] Tetlock and Belkin also stress, "Counterfactual speculation should be constrained by some form of 'minimal-rewrite-of-history' rule that instructs us to avoid counterfactuals that require 'undoing' many events."[38] They recommend a better process that asks what may have worked out differently had easily imagined variations been introduced into the causal matrix of history.[39] Their research also discusses the subjectivity of the individual conducting these thought experiments and how cognitive and motivational biases may affect the overall process.[40]

Dr. Richard Lebow writes how a counterfactual analysis can be used as an effective research tool. He discusses nine principles that must be followed to create plausible counterfactuals.[41] Lebow uses a variation of four of the criteria identified by

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[35] Philip Tetlock and Aaron Belkin, eds., *Counterfactual Thought Experiments in World Politics: Logical, Methodological, and Psychological Perspectives* (Princeton, NJ: Princeton University Press, 1996).

[36] Ibid.

[37] Ibid., 17–18.

[38] Ibid., 7.

[39] Ibid., 8.

[40] Ibid.

[41] Richard Ned Lebow, *Forbidden Fruit: Counterfactuals and International Relations* (Princeton, NJ: Princeton University Press, 2010).

Tetlock and Belkin, an additional criterion Tetlock created, and he added four of his own.[42] The nine criteria are realism, clarity, logistical consistency or cotenability, enabling counterfactuals should not under cut the antecedent, historical consistency, theoretical consistency, avoid the conjunction fallacy, recognize the interconnectedness of causes and outcomes, and consider second order counterfactuals.[43] Lebow's additional principles capture Tetlock and Belkin's criteria as well as provide a more comprehensive methodology to validate counterfactuals. Although Tetlock and Belkin write their book in 1996 and Lebow adds to some of the criteria they established in 2010, the methodology needs very little revision. The counterfactual process stands the test of time, and only needs adjustments when new practices to use it are identified.

Dr. Noel Hendrickson, Director of the Institute for National Security Analysis, emphasizes the need for counterfactual analyses to assist analysts, strategists, and decision makers in the areas of intelligence and national security. His research discusses three primary purposes for counterfactual reasoning; facilitating causal analysis, overcoming deterministic biases, and incorporating creativity to the analytical process.[44] Hendrickson states, "Counterfactual reasoning represents the most ideal way to analyze possibilities, for it considers what would or might happen if the possibility were to occur, rather than attempting to determine if the possibility itself is probable."[45] His research suggests a prescriptive approach to the counterfactual reasoning process because its focus is to determine if a specific counterfactual claim can be reasonably believed to be true or false.[46] Hendrickson's research proposes a system that consists of three stages: antecedent scenario selection, intermediate state selection, and consequent scenario selection.[47] Hendrickson is the first person that this author is aware of to suggest using

[42] Ibid.

[43] Ibid.

[44] Ibid., 6–7.

[45] Noel Hendrickson, *Counterfactual Reasoning: A Basic Guide for Analysts, Strategists, and Decision Makers, The Proteus Monograph Series* vol. 2, (Carlisle Barracks, PA: U.S. Army War College, 2008), http://www.dtic.mil/dtic/tr/fulltext/u2/a509049.pdf, 6.

[46] Ibid.

[47] Ibid., 22.

counterfactual processes in the homeland security realm. He provides a very practical formula organizations can use to adopt counterfactual thought processes to assist them in their missions.

There is extensive research in the field of psychology that shows counterfactual thinking helps doctors better understand the thought processes and behaviors of individuals. Connie Marie Gaglio, a doctor of psychology and associate professor at San Francisco State University, states, "Counterfactuals are evaluated for their plausibility, their likelihood, and their result."[48] In her writing, she describes counterfactual thinking as one of the methods by which entrepreneurs identify innovative market opportunities because it prompts sense making and problem solving. She also identifies counterfactual thinking as a mental stimulation that "enables us to anticipate physical and social environments and to imagine strategies and tactics that would lead to the achievement of our goals, motives, or purpose."[49] Though Gaglio identifies neither law enforcement nor a technological use for the counterfactual analysis, her studies suggest the method has widespread applicability. Gaglio suggests counterfactuals have value because they create better futures by assisting individuals in recognizing past mistakes as well as brighter futures.[50] This is relevant because using counterfactual thought experiments can help law enforcement agencies imagine how technologies could assist them in achieving their goals in the future.

Dr. Timothy Pychyl, an associate professor of psychology at Carleton University, suggests, "Thinking about how things could have been, possible outcomes that did not happen but can be imagined, are known as counterfactual thoughts."[51] In his article, he discusses upward and downward counterfactuals and how it relates to procrastination. He also discusses counterfactual thinking as mental stimulation, similar to Gaglio. However, Pychyl's article on procrastination was not relevant to this thesis.

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[48] Connie Marie Gaglio, "The Role of Mental Simulations and Counterfactual Thinking in the Opportunity Identification Process," *Entrepreneurship: Theory & Practice* 28, no. 6 (2004): 544.

[49] Ibid., 538.

[50] Ibid.

[51] Timothy Pychyl, "Avoiding What Might Have Been," *Psychology Today* (blog), June 5, 2008, http://www.psychologytoday.com/blog/dont-delay/200806/avoiding-what-might-have-been.

NASA analysts William Gertsenmaier, Scott Goodwin, and Jacob Keaton, discuss how counterfactuals can be used to fight biases to prepare for and manage unexpected events in the future.[52] They provide an example where counterfactual thought experiments were used to safely land the space shuttle Endeavour. Their article provides a real-world example of how counterfactuals were used during an incident. They also discuss the benefits of reviewing past decisions to identify potential risks that can be analyzed and tested.[53] The importance of this article is it provides a successful application of counterfactuals in the real world. Much of the literature on counterfactuals provides alternative histories that may have occurred; however, their story discusses how counterfactuals were applied to resolve an issue as it was happening.

There is no literature that applies a counterfactual analysis to emerging technologies for the law enforcement field, per se. Counterfactuals are often used in the fields of psychology, social sciences, and history, but they are not currently used in the criminal justice field. No one within the law enforcement community has considered using counterfactual thinking as an inexpensive but potentially effective process to analyze the validity of emerging technologies. However, Hendrickson did identify a process to use them in homeland security applications.[54] Tetlock and Belkin identified different types of counterfactual methods as well as criteria to judge their validity. Their criteria could be used to assess the validity of counterfactual processes.[55]

3. Augmented Reality—Law Enforcement

There is a large amount of information on Augmented Reality as new technology is developed for its application. The Internet is flooded with materials and vendors promoting the potential uses of augmented reality devices. There are many articles written describing the benefits and costs Augmented Reality might have on law

[52] William H. Gerstenmaier, Scott S. Goodwin, and Jacob L. Keaton, "Seeing through the Haze: How Counterfactual Thinking can Help NASA Prepare for the Unexpected," *Ask Magazine*, no. 30 (spring 2008): 9–12, http://appel.nasa.gov/ask-magazine-issue-30-spring-2008/.

[53] Ibid.

[54] Hendrickson, *Counterfactual Reasoning*, 6.

[55] Tetlock and Belkin, *Counterfactual Thought Experiments*.

enforcement. This section focuses on a few sources connecting Augmented Reality with law enforcement.

Joseph Rampolla, a writer for the *AR Dirt*, has written articles on the potential uses for augmented reality in the policing community. Potential benefits for law enforcement, according to Rampolla, include facial recognition, thermal and infrared sensors, unmanned aerial vehicles (UAVs), officer tracking, and motion control.[56] Furthermore, Ben Reed, with the Redding Police Department, writes about emerging technologies in the Federal Bureau of Investigation (FBI) *Law Enforcement Bulletin* and mentions Augmented Reality as one of them. Similar to Rampolla, Reed describes the potential benefits of Augmented Reality for police.

Michael Buerger and Thomas Cowper's 2003 article addresses how augmented reality will benefit law enforcement in the future.[57] Both are members of the Futures Working Group (FWG) and they forecasted a future technology that could have many capabilities for law enforcement and would run off of multiple technologies. When their paper was written in 2003, the cloud was not even in existence and the technology they identified, Augmented Reality, was still in its infancy. Although Augmented Reality might still be 10 years from its full potential, they identified the usefulness of an emerging technology for law enforcement potentially 20 years ahead of time. Rampolla, Reed, Buerger and Cowper discuss several of the same potential benefits of Augmented Reality, but the paper written by Buerger and Cowper discusses these advantages in much more depth and they identify how different areas of law enforcement may use this technology.

The literature written on augmented reality as it relates to the law enforcement community is not extensive. Many authors write about augmented reality's potential benefits for the law enforcement field but not in any depth. There are a few sources that

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[56] Joseph Rampolla, "Newest Concept of Augmented Vision: The Future of Policing," February 26, 2013, Augmented Reality Dirt, http://www.ardirt.com/general-news/newest-concept-of-augmented-vision-the-future-of-policing.html#sthash.TDbRoiXS.pdf.

[57] Thomas Cowper and Michael Buerger, *Improving our View of the World: Police &and Augmented Reality Technology*, Future's Working Group, accessed July 15, 2014, http://www.fbi.gov/stats-services/publications/police-augmented-reality-technology-pdf.

describe augmented reality in great detail and outline the benefits it has on the law enforcement community. There is currently no use of a counterfactual analysis to assess the validity of augmented reality in the law enforcement field.

4. Conclusion

There exist only a few pieces of literature to identify an overall framework for implementing new technologies. Harris and Romesburg suggest,

> Technology project success depends on user involvement, strong project management and a sound structure for project planning and decision making. Without these essential elements, even the most well intended and state-of-the-art technology is likely to fail, as it would be designed without strong leadership, effective management, proper planning and the support, input and commitment of the end users.[58]

An organization can have the most applicable and cutting edge technology but without providing the proper leadership, management, planning, and support, it will fail. This emphasizes the need to have an actual procedure for identifying emerging technologies. Law enforcement agencies need to implement a process within their strategic plans that enables them to commit resources to recognize and acquire new technologies.

The available research in this topic area is limited. Often the literature is limited to the acquisition of a specific technology. Although a few identify an overall framework they do not suggest looking 10–20 years down the road and how to stay ahead of technology. Much of the research identifies a gap in information that may provide insight to agencies seeking best practices or solutions to common problems when implementing new technology.

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[58] Kelly J. Harris and William H. Romesburg, *Law Enforcement Tech Guide: How to Plan, Purchase and Manage Technology (Successfully!): A Guide for Executives, Managers and Technologists* (Washington, DC: U.S. Department of Justice, Office of Community Oriented Policing Services, 2002), 23.

D. RESEARCH DESIGN

1. Object

This thesis attempted to determine the usefulness of counterfactual analysis in testing the applicability of emerging technologies in law enforcement applications. A counterfactual thought experiment was conducted using a historical event in which the applicability of an emerging technology (or antecedent) was analyzed. The antecedent for this study was Augmented Reality technology in the possession of law enforcement personnel during the Boston Marathon Bombing that occurred on April 15, 2013. This thought experiment sought to identify potential uses of Augmented Reality technology at various junctures in law enforcement response to this event, and hopefully, it will constitute a useful template or model for conducting them regularly and broadly in law enforcement for this purpose.

2. Criteria

This thesis used an "idiographic style" of counterfactual analysis," which Tetlock and Belkin explain as "what could have worked out differently if we introduce easily imagined variations into the causal matrix of history."[59] This process will suggest if X were to occur then Y would or might occur.

This thought experiment was structured using a methodology that incorporates an antecedent scenario, intermediate states, and a consequent scenario; all three are necessary for a rigorous and plausible analysis.[60] The antecedent scenario is the deviation from the actual history that maps the alternate historical path until the time at which the antecedent becomes true.[61] The intermediate states are those events that occur between the time of the antecedent and the time of the possible consequent.[62] The consequent scenario determines what would or might have occurred if the antecedent were true.[63]

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[59] Tetlock and Belkin, *Counterfactual Thought Experiments*, 8.

[60] Hendrickson, *Counterfactual Reasoning*, 20.

[61] Ibid., 20–21

[62] Ibid., 21.

[63] Ibid., 23.

The criteria used to judge the validity of this type of counterfactual thought experiment are clarity, logical consistency or cotenability, and historical consistency. The 117th Boston Marathon bombing was chosen as the case event because of its small temporal window, which is ideal in counterfactual analyses because it decreases the number of intervening variables.

Clarity entails identifying the hypothesized antecedent and consequent.[64] This thesis described in detail the application of Augmented Reality technology as the antecedent. The variables in conjunction with the technology are set forth, and they identify the potential consequences of antecedent use. The logical consistency or cotenability specifies connecting principles that link the antecedent with the consequent. This thought experiment identified those areas of the incident where the use of the antecedent connects the potential outcome of the consequent. The historical consistency is also referred to as the minimal-rewrite rule.[65] The only variable to the original incident will be the placement of the antecedent before, during, and after the incident. There was a very minimal rewrite of history in this process.

Augmented Reality was selected as the emerging technology based on the criteria of the counterfactual style chosen. It is an existing technology, it provides a minimal change to the incident, and it has a number of applicable uses for the law enforcement field. It has the potential to assist law enforcement in areas such as facial recognition, crime scene processing, patrol related duties, license plate recognition, surveillance, search and rescue as well as interview and interrogation.

The Boston Marathon Bombing was selected as the incident for the counterfactual analysis because the event spanned several days and law enforcement personnel had an array of responsibilities before, during, and after the incident. The incident is distinctive in that the suspects were not immediately located, parts of the incident took place in Boston as well as the surrounding areas, and the law enforcement response continued over the course of several days. From the initial response to the apprehension of the last

64 Tetlock and Belkin, *Counterfactual Thought Experiments*, 18.

65 Ibid., 18.

suspect, law enforcement personnel conducted a variety of duties such as surveillance, triage, suspect identification, crime scene investigations, search and rescue, scene security, interview and interrogation, as well as the use of lethal force.

3. Data Sources

The data for this thesis were taken from primary and secondary sources in the scientific, law enforcement, and social science disciplines. This included books, congressional reports or committees such as the Congressional Research Service (CRS), the Government Accountability Office's technology assessment, and the Committee on Science, Space, and Technology, after action reports involving law enforcement response, incident reports from law enforcement agencies, officer accounts, and witness statements. Scientific and technology journals and magazines, such as the *Journal of Nanoscience and Nanotechnology*, the *Journal of Science and Technology*, the *Journal of Frontiers in Science*, will also be utilized, along with manufacturer reports from Defense Advanced Research Projects Agency (DARPA), Science Applications International Corporation (SAIC), BAE Systems, and Department of Defense (DOD). Miscellaneous sources such as news articles, publications, videos, photographs, and web documents were also used,

The topics of this literature range from disasters and catastrophic events, recent law enforcement incidents, law enforcement and technology, military technology, technology adoption/acceptance, Federal Emergency Management Agency (FEMA) / Department of Homeland Security (DHS), and National Incident Management System (NIMS), incident command system, to law enforcement response.

4. Study Limitations

The limitations of this thesis may be the detailed information available on the Boston Marathon bombing. This inquiry will assume that by putting the technology in the hands of trained personnel, they would use the capabilities of the technology during the incident. Along that line, it will also assume each officer responds optimally as trained without mental reservation. It also assumed Augmented Reality technology has all the applications discussed in the current literature.

The thought experiment itself was conducted solely in the mind of the author, which creates some limitation due to biases the author may have toward the incident and the law enforcement response. These limitations and assumptions are based on the author's experience as a law enforcement officer. Therefore, there is an expectation officers would perform their duties and use the technology appropriately.

5. Intended Output

This thesis contains two outputs: an analysis of Augmented Reality as tool for law enforcement, and a policy recommendation for law enforcement agencies on how to construct and execute counterfactual analysis on emerging technologies to identify applicability in the law enforcement arena.

E. OVERVIEW OF CHAPTERS

The introduction chapter provided a basic background and framework for the research method. It also discussed the relevant literature related to counterfactual analysis, law enforcement's adoption of technologies, and Augmented Reality. Chapter II will discuss emerging technologies and their adoption in the law enforcement field, which will provide the foundation for the discussion on Augmented Reality. Chapter III will explain Augmented Reality technology as it currently exists and the potential applications it may have for law enforcement in the future. Chapter IV defines counterfactual analyses and identifies their application in the law enforcement field. It also identifies Augmented Reality as the antecedent, and the 117th Boston Marathon bombing as the event, which will be used in the scenario. Chapter V presents the counterfactual thought experiment as it might have happened if Augmented Reality were available to law enforcement personnel at the 117th Boston Marathon. It highlights decision points, areas where police might have affected the outcome of the incident using the Augmented Reality technology. Chapter VI provides an analysis of the counterfactual thought experiment, the usefulness of Augmented Reality for law enforcement, as well as the strengths and weaknesses of using counterfactual thought experiments. Chapter VII provides a step-by-step process for using counterfactual scenarios to identify the applicability of emerging technologies, as well as areas for further research.

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II. USE OF EMERGING TECHNOLOGIES IN LAW ENFORCEMENT

This chapter discusses the difficulties law enforcement organizations have with identifying and applying emerging technologies within their jurisdictions. There are several issues the law enforcement community encounters due to a lack of procedures to evaluate future technologies. These issues include an organizational culture resistant to change and lack of imagination, rapid technological growth, a quickly adapting criminal environment, and employing the appropriate personnel. Examining these issues may identify potential gaps in evaluating emerging technologies.

A. RESISTANCE TO CHANGE

Humans have a natural tendency to resist change, and this is also a common issue in many policing agencies. Historically, the majority of departments do not easily accept change within their organizations.[66] In other words, change has a tendency to force agencies out of their comfort zones and place them in unfamiliar territory. This type of mentality within the organizational structure of law enforcement can often create adverse effects, especially when considering new technologies. This uneasiness in accepting change may create more issues within agencies and can often be counterproductive to the potential benefits the initial change was supposed to create. In his study of the Los Angeles Police Department (LAPD), Walt Schick suggests, "The attitude of risk aversion was the major catalyst leading to highly restrictive policies and procedures, which in turn resulted in low organizational performance, poor morale, and a corresponding decrease in proactive enforcement tactics and arrests."[67] Basically, Schick is saying the LAPD became accustomed to the barriers it has established and restricted itself from performing

[66] Carl J. Jensen, and Bernard H. Levin, "The World of 2020: Demographic Shifts, Cultural Change, and Social Challenge," in *Policing 2020: Exploring the Future of Crime, Communities, and Policing*, ed. Joseph Schafer (Washington, DC: Federal Bureau of Investigation, 2007), http://futuresworkinggroup.cos.ucf.edu/publications/Policing2020.pdf, 65. pp 31–70.

[67] Walt Schick, "CompStat in the Los Angeles Police Department," *The Police Chief*, January 2004, http://www.policechiefmagazine.org/magazine/index.cfm?fuseaction=display_arch&article_id=190&issue_id=12004.

its mission. This risk aversion created a resistance to change within the organization that ultimately had negative impacts on the community.

If law enforcement continues to resist opportunities to increase its capabilities, its effectiveness in tackling crime may greatly diminish. Levin suggests this "failure to change will foredoom the policing enterprise and pointlessly endanger the fabric of society."[68] The essence of Levin's argument is that, if police cannot adapt to technology and the increasingly sophisticated criminal element, it may lead to devastating consequences for communities. Although this may be an exaggerated claim, it is imperative that the law enforcement community create a paradigm shift in its culture that prioritizes the predictive analysis needed to successfully adopt technologies of the future.

B. RAPID TECHNOLOGICAL ADVANCEMENTS

One of the most daunting challenges facing the law enforcement profession is the continuously shifting environment that not only surrounds the community it polices but the criminal enterprise as a whole. The relationship between technology, police, and the criminal element will continue to grow more complex, and in order to employ the tools of the future, agencies must predict how technology will alter the world of tomorrow.[69] The ability to imagine how emerging technologies may affect the world, as it is known today could provide valuable insight. Visualizing how a technology may impact the mission of an organization, its personnel, and the community it polices may assist in identifying its potential. Understanding how future technologies may impact both the policing community as well as the criminal element may assist agencies to equip themselves with the necessary tools to prevent crime. Prior to looking to the future, Thomas Cowper recommends assessing the impact technology had in our past.[70] Studying the past to determine the implications new technology had on police and the communities they served may assist in avoiding the same mistakes twice. In order for policing to move

[68] Bernard H. Levin, "Human Capital in Policing: What Works, What Doesn't Work, What's Promising?" in *Policing 2020: Exploring the Future of Crime, Communities, and Policing*, ed. Joseph Schafer (Washington, DC: Federal Bureau of Investigation, 2007) http://futuresworkinggroup.cos.ucf.edu/publications/Policing2020.pdf, 418.

[69] Cowper, "Information Age Technology and Network Centric Policing," 73.

[70] Ibid., 75.

forward and confront the challenges it will face in the next decade, a culture of change, of research, and of analysis must be built.[71] It is essential for police organizations to evaluate emerging technologies and willingly accept the changes they may potentially encounter in order to enhance their capabilities. This will assist them in providing the highest level of service to their communities.

Advances in technology have created new tools for police agencies, and many more are on the horizon. Youngs suggests the law enforcement field is attempting to use the vast array of new technologies available to make its mission more efficient.[72] Unfortunately, when resources become available, organizations are often ill prepared to select the most appropriate technologies. This dilemma is compounded by the various types of tools available to accomplish the same task, and the fact that the surrounding jurisdictions may all use different technologies. In the past, many agencies would utilize the same technologies as neighboring departments. In order for law enforcement to police their communities, it must choose the most relevant technologies to maximize its resources. Without a process to identify emerging technologies, police agencies run the risk of selecting tools that may create unforeseen consequences. Some of these effects may be putting officers and citizens at unnecessary risk, violating civil rights and liberties, as well as wasting resources on ineffective technologies. Charles Heal, Thomas Cowper, and Andreas Olligschlaeger describe the balance needed when deploying technology:

> Its use for law enforcement and homeland security in the coming years is essential if we are to provide for the safety of our cities and neighborhoods, but used unwisely by government it could have an adverse impact on civil liberties and social stability.[73]

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[71] James A. Conser and Gordon G. Frissora, "The Patrol Function in the Future: One Vision," in *Policing 2020: Exploring the Future of Crime, Communities, and Policing*, ed. Joseph Schafer (Washington, DC: Federal Bureau of Investigation, 2007), http://futuresworkinggroup.cos.ucf.edu/publications/Policing2020.pdf, 185.

[72] Alan Youngs, "The Future of Investigations," in *Policing 2020: Exploring the Future of Crime, Communities, and Policing*, ed. Joseph Schafer (Washington, DC: Federal Bureau of Investigation, 2007), http://futuresworkinggroup.cos.ucf.edu/publications/Policing2020.pdf, 201.

[73] Cowper, Heal, and Olligschlaeger, "Law Enforcement Technology 2015," 29.

Their point is that, although technology is imperative for law enforcement organizations to effectively police its communities, adopting the most applicable tools and understanding the implications they may pose on society is essential. Consequently, some organizations prefer technologies that have been field-tested by other communities versus taking risks on emerging technologies that have not been thoroughly examined. An organization must determine whether a particular technology that has been readily adopted by most of the policing community will be an effective tool.

The law enforcement community must research how developing technologies may impact their organizations and the public they serve. In Cowper's view:

> Investments in new technology, without serious and comprehensive thinking about how the new technology will be used to conduct policing, will be a waste of time and taxpayer money, failing to provide the security and liberty many citizens expect and deserve in the face of modern criminal and terror networks.[74]

In making this comment, Cowper urges the policing community to understand the full range of capabilities technologies can bring to an organization and utilize them to their fullest potential. The public entrusts law enforcement with keeping its communities safe, no matter the sophistication of the criminal element. Therefore, it is important to imagine how officers will be using new technologies, as that is how they may determine whether the technologies are valuable for society.[75] Ultimately, what is at stake here is the safety of both the officers and the communities they police, so organizations must envision the impact of emerging technologies on the population.

C. ADAPTIVE CRIMINAL ELEMENT

As technology has advanced over the last two decades so has the ever-adapting criminal element. Carl Jensen and Bernard Levin suggest the law enforcement field is at a crossroads; they believe it can either continue to apprehend common criminals as in the past, or determine how vested it will become in catching the more sophisticated offenders

[74] Cowper, "Information Age Technology and Network Centric Policing," 79.

[75] Ibid.

of the future.[76] Organizations will need to make difficult decisions in regards to their future. They can continue to adapt and strive to stay ahead of the corruption in society, or they can struggle to keep up with the evolving criminal component. Heal, Cowper, and Olligschlaeger claim that criminals and terrorists will use technology to create new types of crime against the innocent, and have a greater ability to avoid apprehension.[77] Keeping pace with current criminals will continue to be a challenge. Agencies investigating more high-tech offenders will need to understand the technologies being used to commit crime, as well as the technologies needed to prevent it. Unfortunately, those agencies that fall behind may never catch up.[78] Those departments that are reluctant or incapable of confronting sophisticated criminals may find their gap in enforcement filled by another police agency or the private sector.[79] The private sector usually has the funding and is often already utilizing technology to prevent high-level attacks. Unless the law enforcement community transitions to a more imaginative and innovative vision, its personnel may never develop the skills or acquire the technology needed to successfully traverse the twenty-first century.[80]

The success of law enforcement in the future may rest on its ability to think more proactively rather than reactively. Joseph Schafer emphasizes that agencies at the state and local levels are heavily structured to respond to incidents that have already occurred.[81] The composition of most police agencies is oriented towards response; therefore they often lack the ability to recognize future trends in crime. However, with the accelerated pace of technology, the success of an organization may depend on its ability to forecast its future needs. Unfortunately, there are not many agencies or police

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[76] Carl Jensen and Bernard Levin, "Homeland Security in 2015," in *Homeland Security: 2015 Proceedings of the Futures Working Group*, vol 2, ed. Michael Buerger (Washington, DC, Federal Bureau of Investigation, 2006), http://futuresworkinggroup.cos.ucf.edu/docs/Volume%202/FWG%20Homeland_Security_2015.pdf, 14.

[77] Copwer, Heal, and Olligschlaeger, "Law Enforcement Technology 2015," 29.

[78] Jensen and Levin, "Homeland Security in 2015," 14.

[79] Ibid.

[80] Jensen, and Levin, "The World of 2020," 33.

[81] Joseph Schafer, ed., "Thinking about the Future of Policing," in *Policing 2020: Exploring the Future of Crime, Communities, and Policing* (Washington, DC: Federal Bureau of Investigation, 2007), http://futuresworkinggroup.cos.ucf.edu/publications/Policing2020.pdf, 19.

leaders that have the inclination to conduct analyses of broad future issues and considerations.[82] In fact, many law enforcement officials still seem satisfied solving yesterday's problems tomorrow.[83] They do not project the issues they may encounter in the future, nor do they consider the affects technologies will have on their futures. Some law enforcement leaders are often content with the progress of their agency as long as crime is limited within their communities and the public is satisfied with their work. They do not project the issues they may encounter in the future, which may exceed their capabilities. Many organizations often look at the issues at hand but not those that may affect or prepare the agency 10, 15, or even 20 years into the future.

D. EFFECTIVE WORKFORCE

Law enforcement personnel have untapped abilities that agencies can use in conjunction with technology. Unfortunately, the talents of the workforce are often not realized. Heal, Cowper, and Olligschlaeger discuss the complications and controversy between police agencies and technology stating,

> While there have been many successful implementations throughout the last century, more often than not new technology initiatives, big and small, have fallen far short of expectations, both of the police who use them and the public upon which they are used.[84]

Their point is that, while organizations have achieved some success deploying new technologies in the field, they typically create issues for both the agencies and communities. Unfortunately for the law enforcement field, this trend will only continue, as there are more technology choices now than there have ever been and the associated systems for these technologies are far more sophisticated, intricate, and powerful than ever before.[85] Therefore, agencies will need to recruit a workforce that has the ability to understand the impact technologies will have on the communities they police as well as the knowledge needed to operate them effectively.

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[82] Ibid.

[83] Jensen and Levin, "The World of 2020," 33, 65.

[84] Copwer, Heal, and Olligschlaeger, "Law Enforcement Technology 2015," 29.

[85] Ibid.

The personnel employed by police organizations are a critical component to the success or failure of an agency's implementation of new technology. In looking to the future, departments will need to examine not only the technologies being used but also the individuals that are operating them.[86] Because of the growing sophistication of the criminal element, law enforcement professionals in the future will require more diverse education and training. Jensen and Levin suggest, "Some of the best future ideas in policing will likely come from disciplines that have nothing … to do with law enforcement."[87] In other words, the policing community does not typically create new innovations for itself; it is often another discipline or institution that discovers solutions for the law enforcement community. In order to successfully implement future technology in the field, the profile of the police officer must change from what it is today. Those individuals entering the law enforcement profession may need to have degrees in areas such as computer science, computer programming, chemistry, and languages.88 Employing individuals with different educational backgrounds may stimulate creativity that could assist an organization in becoming more successful. Workers that have different backgrounds may approach problems with different perspectives and propose more creative solutions.

Law enforcement leaders also need the education and imagination to forecast how these technologies will be utilized within their agencies. The continually changing landscape surrounding the policing community and its transition into the future will require very professional, highly educated, and well-trained personnel.[89] The success of organizations will increasingly depend on their ability to attract and acquire the most capable personnel and acquire technologies that may enhance the capabilities of its agencies. However, the ability to accomplish a balance of both may largely depend on the funding allocated to them.

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[86] Cowper, "Information Age Technology and Network Centric Policing," 74.

[87] Jensen, and Levin, "The World of 2020," 33.

[88] Youngs, "The Future of Investigations," 210.

[89] Conser and Frissora, "The Patrol Function in the Future: One Vision," 176.

E. CONCLUSION

When strategizing for the future, law enforcement agencies often concentrate on the issues of the day and seldom analyze the issues of the future.[90] The inability to identify potential threats in the future and to assess their impacts could prove disastrous for police organizations and the communities they protect. As technology provides new avenues for criminals to exploit society, it is imperative law enforcement organizations look beyond the offenses that currently exist and identify future technologies that may prevent the effects of future crimes. In discussing the ability of police to envision the future, Conser and Frissora caution, "some visions fall short and others may never occur. This process of assessing trends to envision the future is not foolproof; it is not an exact science."[91] In other words, forecasting the potential issues that may affect the law enforcement field in the future may not be enough to successfully protect its communities. However, it may provide police executives with a vision on how they want to protect their communities. It could also help them understand the forces that will affect their agencies, and it may assist them in identifying technologies to increase their capabilities. The law enforcement community will need to efficiently manage its resources and identify emerging technologies that can assist them in meeting the various challenges they may face in the future.

Police organizations must have the ability to recognize potential criminals in the future and to leverage technology and personnel to keep their communities safe. In order to be successful, police must continually adapt to increasingly changing technologies and create enhanced methods to fulfill their missions.[92] The operational success and survival of the law enforcement will greatly depend on its ability to recognize future threats and the emerging technologies needed to adapt in an ever-changing criminal landscape. Unfortunately, government agencies continue to create barriers that prohibit their ability to simplify the purchasing process to allow timely acquisition of those technologies.[93]

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[90] Schafer, "Thinking About the Future of Policing," 19.

[91] Conser and Frissora, "The Patrol Function in the Future: One Vision," 176.

[92] Cowper, "Information Age Technology and Network Centric Policing," 71.

[93] Cowper, Heal, and Olligschlaeger, "Law Enforcement Technology 2015," 31.

Therefore, public agencies need a process to procure new technology in a timely manner so their use in the field is maximized. The successful identification and adoption of emerging technologies may greatly affect the world in which we live, the world we have to police.[94] Therefore, a process needs to be created that will assist the law enforcement community in identifying future technologies and their applicability in the field. The next chapter will discuss an emerging technology, called Augmented Reality, which could have a significant impact on the law enforcement field.

[94] Jensen and Levin, "The World of 2020," 34.

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III. AUGMENTED REALITY

This chapter will discuss Augmented Reality and examine the potential impacts it may have on the law enforcement community. This section will provide a background and definition of Augmented Reality, the different types of Augmented Reality technology, specific applications already in production, as well as potential advantages and disadvantages for police organizations. Additionally, this segment will explore how the potential use of Augmented Reality may enhance situational awareness and increase the overall capabilities of law enforcement personnel while policing their communities. Although this chapter will discuss Augmented Reality technologies and applications (apps) they will not be reviewed in great detail, as they are not pertinent to this thesis. However, the capabilities of those devices and apps will be examined in more detail.

A. BACKGROUND

Advancements in science bring about new solutions for law enforcement that may not only change its operational procedures but could have a significant impact on crime. Augmented reality has the potential to become one of the most important technologies in revolutionizing police agencies and their responses to criminal activities. According to James Kent's research, as of 2011, augmented reality is being used in the following applications: advertising, navigation, industrial, military, emergency services, art, architecture, collaboration, entertainment and education.[95] Augmented reality may present numerous benefits for law enforcement personnel in such areas as command and control, response, officer safety, and crime scene investigation.

The policing community has become more reliant on technology in almost every aspect of its work to prevent and fight criminal elements that often employ more advanced technologies to commit unlawful acts. By utilizing technologies like Augmented Reality, law enforcement may become more efficient in accomplishing its work. Michael Buerger and Thomas Cowper believe although organizations continue to

[95] James Kent, *The Augmented Reality Handbook: Everything You Need to Know about Augmented Reality* (Brisbane, Australia: Emereo Pty. Ltd., 2011).

rely on intelligence and traditional police work to accomplish their mission, they are also becoming more reliant on advanced technologies to maintain domestic security.[96] Buerger and Cowper are correct in their statement, technologies such as facial recognition, less lethal weapons, and gunshot detection equipment are just a few technologies being used to increase law enforcement capabilities. Systems such as Augmented Reality have the capability to not only assist the law enforcement community in combating conventional criminal activity but may also be utilized for high-tech crimes. Linda Gilbertson emphasizes the need for agencies to be cognizant of newer technologies such as Augmented Reality and the potential benefits they present, which may improve the outcome of policing activities and increase public safety.[97] Technologies are important for law enforcement because they even the playing field when departments lack resources to achieve their mission as well as when they are combatting tech savvy criminals. As previously mentioned, Augmented Reality has many potential applications for law enforcement agencies and their personnel.

B. TYPES OF AUGMENTED REALITY TECHNOLOGY

There are three primary types of augmented reality interfaces that law enforcement may employ. Kent identifies these displays as head-mounted (HMD), handheld, or spatial.[98] HMD (Figure 1) interfaces consist of either a helmet or set of glasses that enable the user to view images in one or both eyes. This type of device could be used by law enforcement officers on patrol, either on foot or in their vehicles. The handheld display (Figure 2) typically consists of three types of devices: cellular phones, personal digital assistants (PDAs), or tablet PCs.[99] Simply scanning an area with the device may provide information about the objects within the field of vision. The third type of augmented reality interface is spatial augmented reality (SAR) (Figure 3), in

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[96] Cowper and Buerger, *Improving our View of the World*, 3.

[97] Linda Gilbertson, "Using Technological Advances to Improve Policing Outcomes," Police One, September 24, 2013, http://www.policeone.com/Grants/articles/6465669-Using-technological-advances-to-improve-policing-outcomes/.

[98] Kent, *The Augmented Reality Handbook*, 4.

[99] Daniel Wagner and Dieter Schmalstieg, *Handheld Augmented Reality Displays* (Graz, Austria: IEEE Computer Society, 2006), 1.

which images are projected on a screen or another physical object. Kent explains the use of SAR promotes collaboration as multiple users can see each other at the same time, and they do not have to wear an HMD.[100] This type of device would also allow several users to share information without physically being at the same location. All three types of augmented reality technology have the potential to benefit the law enforcement community.

Figure 1. Head-Mounted Display[101]

[100] Kent, *The Augmented Reality Handbook*, 4.

[101] Ben Lang, "Google Glass Announces Project Glass, Wants to Bring Augmented Reality and Wearable Computing to the Masses," Road to VR, April 4, 2012, http://www.roadtovr.com/google-announces-project-glass-wants-to-bring-augmented-reality-and-wearable-computing-to-the-masses-video/.

Figure 2. Handheld Display[102]

Figure 3. Spatial Augmented Reality[103]

[102] Matthew Buckland, "The Future of Social Networking: A Concept Investigation with Augmented Reality," Mathew Buckland, August 22, 2010, http://matthewbuckland.com/?p=1041.

[103] Alan Robles, "Gensler and the Hive Debut Pioneering Spatial Augmented Reality Experience," Gensler on Lifestyle, August 15, 2013, http://www.gensleron.com/lifestyle/2013/8/15/gensler-and-the-hive-debut-pioneering-spatial-augmented-real.html.

C. CURRENT APPLICATIONS

Augmented reality applications and devices are currently being developed for public consumption. Some of the HMD devices in production include Google Glass, Golden-i, VR Pro Augmented Reality, and K-Glass. Handheld devices, such as cell phones and tablets, use apps to enhance the world around an individual by displaying images that modify what is normally seen. There are dozens of Augmented Reality apps for mobile devices: LAYAR, Google Goggles, Google Sky Map, Acrossair and Wikitude World Browser, for example.[104] Typically, SAR devices consist of projectors and monitors that can display images on physical objects.

In the 1960s, the U.S. military began investing in augmented reality technology for its fighter pilots.[105] Since then augmented reality is used in both its operations and training.[106] The U.S. military uses augmented reality in a variety of applications. It is being used in planes, flight simulators, and vehicles. Additionally, it used for training in flight simulators, mapping for missions, as well as maintenance and repair of vehicles, and the field of medicine.[107] One of the military's main objectives is to obtain situational awareness for its personnel.[108] Pilots wearing Augmented Reality headgear can see the positions of enemy and friendly personnel as well as the equipment they are using.[109] Having the ability to obtain situational awareness for both field personnel and the command post has dramatically changed military operations.

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104 Sarvesh Chandra, *Top 20 Augmented Reality Apps for Android and iPhone/iPad Users*, Deep Know How, April 4, 2013, http://deepknowhow.com/2013/04/04/top-20-augmented-reality-apps-for-android-and-iphoneipad-users/#GAxjZzBEtyizsIOk.99.

105 Mark A. Livingston et al., "Military Applications of Augmented Reality," in *Handbook of Augmented Reality*, ed. Borko Furht, 671–706 (New York: Springer, 2011).

106 Ibid.

107 Ibid.

108 Ibid.

109 David Nicholson, "AR for Military, Medical and Education," *Engineering and Technology Magazine*, April 2013, http://eandt.theiet.org/magazine/2013/04/augmented-reality-grows-up.cfm.

D. ADVANTAGES OF AUGMENTED REALITY

There are many areas of application in the law enforcement community for Augmented Reality. By using Augmented Reality, the law enforcement community has the potential to increase situational awareness and officer safety by registering high value graphical displays, which deliver the relevant, critical information for a user's current context. This greatly improves situational awareness, leading to faster and more informed decision making.[110] The ability of law enforcement officers to receive real-time information on people, vehicles, buildings, and the location of other responders potentially increases their ability to make more accurate and better decisions based on data received through Augmented Reality.

When responding to an incident, with augmented reality technology, law enforcement personnel would be provided continuous information about the situation they are approaching. They would have the ability to receive live or recorded video feeds from the incident or crime scene as seen by other responders, officers, security cameras, and potentially civilians wearing Augmented Reality technology. These live feeds could be sent to their Augmented Reality device and display what occurred as well as possibly identifying suspects, victims, witnesses, and other potential hazards. The ability to obtain constant situational awareness and information regarding the incident may provide increased safety to officers and citizens on scene.

Arriving on the scene of an incident with knowledge of the potential hazards, threats, and individuals involved gives an officer the opportunity to plan a course of action prior to his/her arrival. Officers may have the potential to see exactly where a suspect is and what he/she is doing or has done. Augmented reality technology has the potential to monitor an officer's physical and mental state. Augmented reality devices may be equipped to inform a commander, a responding paramedic, or personnel at the hospital of an officer's vital signs, allergies, blood type, and injuries. This information

[110] Simon Julier et al., "BARS: Battlefield Augmented Reality System, Advanced Information Technology," in *NATO Symposium on Information Processing Techniques for Military Systems*, Washington, DC, 2000.

would be invaluable to medical personnel who may only have seconds or minutes to save a life.

Commanders often receive situational awareness from their officers on scene via radio, dispatch centers, and open media sources to obtain a common operating picture. Augmented reality technology would potentially enhance the command and control of situations where commanders are not on scene. Just as a responding officer could view situations prior to arriving to a scene, law enforcement commanders would have the ability to receive the same information as well as the view from their officers' Augmented Reality device. This may provide them with pertinent information they need to make decisions based on what they are seeing and not what is being reported to them over a radio. They may identify something the officer has missed or may see potential dangers in a certain area where officers can be directed. Commanders may know the location of personnel from their agency as well as other responding agencies so they could manage resources on scene to resolve any issues as efficiently as possible.

Augmented reality devices would greatly enhance investigations. Officers investigating crimes would be able to record everything they did while on a scene. They could leave a crime scene and link follow up information or interviews back to the original incident and have a video and recording of everything that transpired. There would be no need to type original or supplemental reports. Views from other officers with different perspectives from the scene could be added to the original complaint so one would be able to view a situation from several angles. During interviews, Augmented Reality technology could identify physical behaviors associated with lying and potentially act as a polygraph machine. Other detectives and commanders could observe an officer's interview and provide input or suggestions based on what they are observing from witness, suspects, and victims.

E. ADDITIONAL BENEFITS OF AUGMENTED REALITY TECHNOLOGY

Augmented reality has the ability to enhance law enforcement in a variety of circumstances such as in biometric identification, language translation, thermal imaging, three-dimensional maps, advanced optical lenses, live video feeds, night vision, and

officer tracking. According to Greg Anderson's research, Augmented Reality allows an officer to interact with other systems that allow the individual to

> Automatically and hands-free receive maps with specific points of interest related to his current location, display alerts from motion sensors, call video feeds from nearby surveillance cameras and even remotely trigger lights or sirens in specific parts of a building.[111]

Basically, Anderson is saying Augmented Reality technology may enable police to communicate with other systems allowing them to perform multiple tasks by simply using voice commands. This may not only provide excellent situational awareness but could allow an officer to command or utilize other systems to assist with his/her duties.

A major benefit of this technology is its ability to enhance navigation and to provide information regarding locations and occupants. A law enforcement officer on patrol will have a digital overlay directing the fastest and shortest route to an address or scene by instantly processing current traffic patterns. As the officer approaches the location the Augmented Reality technology would show each address on his or her display as she or he passes them and advise who the occupants are at that specific location. Once the officer arrives, he/she could be given specific information about each individual residing there such as pictures, physical features, criminal history, driving record, occupation, registered vehicles, and registered guns. The officer would have the potential to see a floor plan and utilize thermal imaging to see where in the house individuals may be located. This information may allow an officer to make informed decisions prior to engaging individuals or entering scenes and increase overall officer safety.

Social media is very prominent today and the use of Augmented Reality may simply enhance an officer's ability to use social networking in crime prevention. Timothy Roufa explains the significance Augmented Reality may have on social media. He describes how prior to Augmented Reality technology, police agencies utilized social

[111] Greg Anderson, "Robocop Technology To Assist Law Enforcement," Arctic Startup, December 5, 2011, http://www.arcticstartup.com/2011/12/05/robocop-technology-to-assist-law-enforcement.

media to obtain information that assisted in preventing and solving criminal activity.[112] He continues by stating, that social media may seem dated to most of society, but its potential as a law enforcement tool is only just beginning.[113] With advancements in Augmented Reality technology social media would create opportunities for the law enforcement community to identify and obtain information that would assist them in the prevention of criminal activity and the apprehension of criminals. While most agree that Augmented Reality may provide law enforcement organizations with incredible capabilities, there are also many potential issues that could arise when it is introduced into society.

F. POTENTIAL ISSUES WITH AUGMENTED REALITY TECHNOLOGY

Although most agree that Augmented Reality may have many benefits for law enforcement personnel, there are also many potential issues surrounding this technology. Emerging technologies like Augmented Reality may bring about unintended consequences that create problems for both the law enforcement field and the communities they police. Matthew Fraedrich emphasizes this point: "It is possible that Augmented Reality will evolve to be the most dangerous and manipulative technology to date."[114] Basically, Fraedrich is saying Augmented Reality may provide opportunities for individuals to harm other members of society. Unfortunately, these issues arise when individuals use technologies for purposes that were not originally intended. When new technology is introduced into society, it often raises concerns with citizens because it may affect privacy, civil liberties, or civil rights. Too often, the law enforcement community adopts technologies that have not been field tested within communities to identify potential issues the technologies may cause when introduced to society. Augmented reality is an emerging technology that has the potential to encounter all of the aforementioned issues.

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[112] Timothy Roufa, "Technologies That Are Changing the Way Police Do Business," About.com, accessed June 20, 2014, http://criminologycareers.about.com/od/Career_Trends/a/Technologies-That-Are-Changing-the-Way-Police-Do-Business.htm.

[113] Ibid.

[114] Matthew Fraedrich, "Running Head: Augmented Reality," George Mason University, October 2012, http://mason.gmu.edu/~mfraedri/Research%20Paper.pdf, 5.

A major concern with Augmented Reality technology is that the constant information fed to officers may distract them from their real-world experience. In addition, this technology may cause officers to pay less attention to what is happening right in front of them as layers of information divert their attention. One Augmented Reality study on selective attention by Bøttern et al. found, "perceptual load influenced reaction times."[115] In other words, this technology slowed an officer's reaction time, which in the real world may affect the occupational safety of the officer as well as the safety of the public. In Brian Wassom's view, "The more immersive a user's experience (or 'UX') is, the less the user consciously perceives the augmented content as being separate from, or inferior in quality or value to, what he sees with his naked eye."[116] In making this comment, Wassom suggests the more deeply involved one becomes with Augmented Reality, the harder it will become to differentiate what is real and what is augmented. The ability to survey an area while continually receiving information about buildings, people, vehicles, and almost everything else around is a safety issue that must be taken into consideration.

Augmented reality brings with it many privacy issues as it gives anyone the ability to obtain information about anyone and everything else without obtaining permission. Gregory Conti et al. warns, "What might be relatively private today (such as … identity, current location, or recent activity) will be much more difficult to keep private in a world filled with devices like Google Glasses."[117] In other words, devices like Google Glass may be as widely used as tablets and cell phones but with many more capabilities. Therefore, the ability to blend in with society when one is in public may be impossible. Law enforcement personnel equipped with an Augmented Reality device would have the ability to immediately recognize individuals without asking for identification and track individual movements through other Augmented Reality users.

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115 Tomas Bøttern et al., "Selective Attention in Augmented Reality," Aalborg University Copenhagen, http://schnit zel.dk/rasmus/files/med7paper.pdf.

116 Brian Wassom, "Augmented Reality Addiction: Could Augmented Reality Get Too Immersive?," Wassom, November 10, 2012, www.wassom.com/augmented reality-addiction-could-augmented-reality-get-too-immersive-from-the-archives.html#sthash.1h9TUACL.pdf.

117 Gregory Contie et al., "Unintended, Malicious and Evil Applications of Augmented Reality," Help Net Security, February 12, 2013, http://www.net-security.org/article.php?id=1807&p=4.

An officer's Augmented Reality interface would potentially identify a vehicle registration and provide the owners name, address, vehicle type, driving record, and criminal history.

In all likelihood, an Augmented Reality device would enable an officer to use voice commands to obtain enormous amounts of information without lifting a finger. Vincent Wegener emphasizes how Augmented Reality may enable individuals to obtain information about anyone as well as record everything someone does without permission.[118] Wegener's point is that everything someone does outside their home might be recorded without their consent. No matter where an individual goes, strangers may obtain their personal information by just walking by them. People walking the dog, going to the store, watching a movie, going to the park, or traveling to see a friend may be recorded the entire time by any person equipped with an Augmented Reality device. In Wassom's view, Augmented Reality technology will create an environment where "there is no expectation of privacy that prevents anyone from taking your photograph in open, public places."[119] Wassom is right about the potential privacy concerns that may occur with this technology. In order to preserve the freedoms of individuals, some laws may have to include specific language governing Augmented Reality.

G. CONCLUSION

It is imperative that law enforcement decision makers understand how advancements in technology may enhance their ability to perform specific work functions. They must establish a framework to identify emerging technologies as well as their effect on agencies and communities. According to Michael Buerger and Thomas Cowper, "The critical component to effective policing in a rapidly changing world is this ability to think creatively about emerging technologies and how they can be used successfully within the constitutional limitations of a free society."[120] In making this

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[118] Vincent Wegener, "Augmented Reality: Can We Cope with the New Reality?," April 13, 2012, http://singularityuniversitynl.wordpress.com/2012/04/13/augmented-reality-can-we-cope-with-the-new-reality/

[119] Brian Wassom, "Forget Facial Recognition–Body Recognition May Be the Real Privacy Concern," April 24, 2011, http://www.wassom.com/forget-facial-recognition-body-recognition-may-be-the-real-privacy-concern.html#sthash.reaxx8um.dpuf

[120] Cowper and Buerger, *Improving our View of the World*, 12.

comment, Cowper and Buerger urge police organizations to identify future technologies as well as recognize the legal ramifications they may have on society. In an era where criminals and terrorists utilize technology to their advantage, it is essential for law enforcement officials to combat this threat by providing their agencies with the foresight and personnel to adopt emerging technologies.

Once a police organization identifies a promising, sophisticated technology, such as Augmented Reality, that is disruptive, expensive, and has the potential to change many mission areas how does a department evaluate it? Especially when the agency realizes it has potential ethical and legal issues, as well operational consequences that are not well understood or predicted. When a law enforcement agency identifies such a technology, it often contacts the manufacturer or the research and development stakeholders. Another method it might use to obtain more information is through basic discovery: determining who is using it and with what results. However, a third approach is to theoretically insert it into a contextually applicable (law enforcement specific) scenario and rerun it as carefully and comprehensively as possible examining all aspects of the technology. Then the police agency can conduct an analysis of its findings and provide recommendations.

Augmented reality has the ability to affect almost every aspect of life, so the law enforcement community must carefully examine its potential issues as well as the concerns that surround this technology. Counterfactual thought processes might provide the law enforcement community with a tool to recognize emerging technologies like Augmented Reality, and weigh its potential benefits and risks. The next chapter will discuss the counterfactual thought process and how using it could identify the advantages and disadvantages of technologies like Augmented Reality.

IV. COUNTERFACTUALS

This chapter will discuss counterfactuals and their ability to stimulate creative thinking. It will discuss how counterfactual thought experiments might benefit law enforcement in identifying emerging technologies.

Though counterfactuals literally contradict fact, they may provide a framework for understanding what may have happened had something different occurred during a particular event.[121] Counterfactuals are "what if" statements that generate assertions about incidents that have not occurred.[122] People often wonder what could, would, or should have happened if incidents occurred differently than they had.[123] This counterfactual thought process occurs in almost every person. Individuals and organizations often look at past incidents and wonder how things could have been different. This is especially true after catastrophic events such as World War I, Pearl Harbor, Columbine, 9/11, and Hurricane Katrina. Following events like these, people begin asking "what if" questions to determine if circumstances had been different could these incidents have been avoided or prevented. In his book *Forbidden Fruit*, Richard Ned Lebow maintains, "Counterfactual thought experiments provide a vantage point for taking ourselves out of our world and our assumptions about it where they can be subjected to active and open interrogation."[124] Lebow's point is that using counterfactual thought experiments allows individuals to step back and creatively think about situations in different ways and ask questions about causation. He adds that these experiments assist in recognizing assumptions, encouraging new thoughts, and enabling people to form hypotheses.[125] This is critical because understanding traditional thought processes and biases, particularly hindsight biases, may prevent an organization from making the same

[121] Keith D. Markman et al., "Implications of Counterfactual Structure for Creative Generation and Analytical Problem Solving," *Personality & Social Psychology Bulletin* 33, no. 3 (2007): 312–324.

[122] James D. Fearon, "Counterfactuals and Hypothesis Testing in Political Science," *World Politics* 43, no. 02 (1991), 169–195.

[123] Markman et al., "Implications of Counterfactual Structure."

[124] Lebow, *Forbidden Fruit: Counterfactuals and International Relations*, 5.

[125] Ibid.

mistakes, thus allowing them to create potential solutions to problems. Counterfactual thought experiments educate individuals and organizations because they allow people to focus their attention on specific issues.[126]

In discussions on counterfactuals, one controversial issue is whether they provide any real benefit. While some argue they are simply stories of fiction used for entertainment, others contend they are important thought experiments that provide value. Steven Weber urges, "Counterfactuals can also be used to open minds, to raise tough questions about what we think we know, and to suggest unfamiliar or uncomfortable arguments that we had best consider."[127] In other words, Weber believes counterfactuals can be effective tools in creating dialogues that might not otherwise arise and in encouraging individuals to consider issues that might be difficult to contemplate. Additionally, this thought process encourages individuals to think innovatively and recognize potential outcomes based on past experiences. It is this last benefit that may greatly assist police organizations in determining the potential risks and benefits of future technologies.

As discussed in Chapter I, to create meaningful and well-crafted counterfactual thought experiments there are certain criteria that should be considered. When making decisions, leaders often identify issues and potential solutions and then evaluate the consequences of each choice using counterfactual analysis.[128] This process allows leaders to view a situation from different approaches and select the option that has the most favorable outcome. To create a plausible counterfactual argument it is important to identify specific conditions that must exist for the antecedent to happen.[129] Crafting a

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[126] Michael W. Morris and Paul C. Moore, "The Lessons we (Don't) Learn: Counterfactual Thinking and Organizational Accountability after a Close Call," *Administrative Science Quarterly* 45, no. 4 (2000), 737–765.

[127] Steven Weber, "Counterfactuals, Past and Future," in *Counterfactual Thought Experiments in World Politics: Logical, Methodological, and Psychological Perspectives* eds. Philip E. Tetlock and Aaron Belkin (Princeton, NJ: Princeton University Press, 1996), 268.

[128] Richard Ned Lebow and Janice Gross Stein, "Back to the Past: Counterfactuals and the Cuban Missile Crisis," in *Counterfactual Thought Experiments in World Politics: Logical, Methodological, and Psychological Perspectives* eds. Philip E. Tetlock and Aaron Belkin, (Princeton, NJ: Princeton University Press, 1996), 119–148.

[129] Ibid.

counterfactual thought experiment in this manner will lend credence to the argument as long as the assumptions are not farfetched.

Counterfactuals provide law enforcement a method to assess emerging technologies and recognize the potential impact they may have in the future. According to Steven Weber, "They focus attention on what is most important, in an effort to force people to look straight on at critical junctures and possible surprises that might change the world they live in."[130] In other words, Weber believes counterfactuals get to the heart of the matter and identify areas where issues or unexpected problems may arise. Using counterfactuals to predict future outcomes in an attempt to reduce the possibility of negative impacts is very important. Police agencies can use these scenarios to detect weaknesses in their own thought processes and minimize their biases to analyze future technologies. This is significant because law enforcement rarely have the occasion to assist in the research and development of technologies or the ability to test them. Counterfactuals provide an opportunity for organizations to conduct assessments of emerging technologies to determine their applicability in the future.

Testing technologies for law enforcement can often be completed in laboratories or in controlled environments, but too often, technologies are implemented in society without contemplating the effects on agencies and the civilian population. Police often look to technologies to assist them in completing their missions but do not recognize the issues they may cause for their communities. Success in the field depends on recognizing the impact technologies may have outside of a laboratory. A recent example of what not to do was the Seattle Police Department's (SPD) purchase of two drones with homeland security funds. The agency received the necessary permits from the FAA, purchased the drones, and prepared to use them. Unfortunately, when the members of the public became aware of the department's plans, they voiced their concerns regarding privacy issues and the fact they were not included in the discussions.[131] As a result, the drone program was cancelled. If the SPD, had used a counterfactual process, it may have anticipated public

[130] Weber, "Counterfactuals, Past and Future," 287.

[131] Dante D'Orazio, "Seattle Mayor Scraps Police Department's Drone Program after Strong Public Opposition, The Verge, February 9, 2013, http://www.theverge.com/2013/2/9/3970614/seattle-police-department-drone-program-scrapped-by-mayor

opposition. Since the SPD saw the drones as good investigative tools that would enhance the safety of the community, it moved forward with the project without considering potential impacts. This incident may have been an opportunity for the SPD to use a counterfactual thought experiment to recognize the effects drones may have had on the public prior to their acquisition.

Counterfactual thought experiments may also assist law enforcement agencies in identifying how technologies may perform under certain circumstances. According to Richard Lebow and Janice Gross Stein, "Counterfactuals are necessary to imagine alternative worlds and to construct alternative futures as well as to test explanations of the past to assess their projectability to the future."[132] Basically, they are saying counterfactuals are essential to predict the future because they test prior beliefs as well as visualize the various outcomes. This is important for police agencies because they need to understand the effects future technologies will have when used. Because they rely on past assumptions, departments implement technologies too often without considering the consequences.

Individuals usually feel confident in predicting the future based on past beliefs and biases.[133] This confidence may lead to failure because individuals may only consider what they have experienced or what they believe to be true and they do not consider how politics and public perception may react to their decisions. Several scholars argue that counterfactuals can alleviate the biases developed over time within individuals and organizations. Using counterfactual thought experiments may assist these individuals to open their minds to new ideas they never before considered. William Gertsenmaier, Scott Goodwin, and Jacob Keaton emphasize the need to "believe in our abilities to succeed with our projects and missions and at the same time do everything we can to uncover extreme negative events that can cause failure before they happen."[134] In other words, law enforcement must know its capabilities and at the same time expose issues prior to critical failure.

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[132] Lebow and Stein, "Back to the Past," 119–148, 147.

[133] Lebow, *Forbidden Fruit: Counterfactuals and International Relations*.

[134] Gerstenmaier, Goodwinm and Keaton, "Seeing through the Haze,"12,

When deploying a new technology in the field, a law enforcement organization needs to have, as Lebow puts it, "a high degree of confidence" that it will work as intended.[135] According to Lebow, "In a complex society, individuals, organizations, and states require a high degree of confidence-even if it is misplaced-in the short-term future and a reasonable degree of confidence about the longer term."[136] In making this comment, Lebow identifies the need for people to have a degree of certainty about the future even if they may be incorrect. When faced with uncertainty, people make decisions by attempting to predict outcomes and minimize the possibility of troubling and destructive impacts.[137] This is important because law enforcement needs to understand that it is acceptable to make wrong decisions as long as the organization is moving forward. This underlines how the use of counterfactual thought experiments anticipates biases and minimizes their affects. Using counterfactual thought experiments is valuable because it provides a better system of analysis without having real-world consequences. This type of process fosters a learning environment where future technologies can be examined without fear of failure, and individuals and agencies can examine issues creatively.[138]

Gertsenmaier, Goodwin, and Keaton discuss how using counterfactual thinking may prevent extreme negative events, known as black swans, from occurring because it exposes potential problems that can be tested and analyzed to identify possible solutions.[139] The scholars provide an example of how a counterfactual method was used to make an informed decision on the space shuttle Endeavour when it experienced tile damage during its launch. The decision not to fix the damaged tiles in space prior to landing was inspired by asking "what if" questions. NASA examined the situation by determining what would be the worst-case scenario if the shuttle was not fixed prior to re-entry; several scenarios were tested in their laboratory and it was determined there

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[135] Lebow, *Forbidden Fruit: Counterfactuals and International Relations*, 12.

[136] Ibid.

[137] Ibid.

[138] Gerstenmaier, Goodwinm and Keaton, "Seeing through the Haze."

[139] Ibid.

would be minimal damage if the shuttle returned in its damaged state.[140] The real-life outcome confirmed NASA made the right decision as the shuttle withstood re-entry. As the example illustrates, decision makers need to use counterfactual thinking to recognize potential risks and prepare for issues prior to their occurrence.

Using a counterfactual thought experiment as a process in the identification of technology applicability in law enforcement may enhance the capacity to recognize potential issues before technology procurement or deployment in the community. Keith Markman et al. assert, "Counterfactual thoughts not only reconstruct the past but they drive forward the future by affecting the way individuals approach new tasks."[141] Their point is that when individuals use counterfactual thoughts to assess the past, they generate ideas that may change their actions in the future. These thought experiments may train individuals to think more creatively, which may ultimately lead to change. This is important to the policing community because, as discussed in Chapter III, there is an organizational resistance to change. This process will guide law enforcement out of its comfort zone, thus producing new ideas that may influence its decision making in the future. Police organizations can use counterfactual analyses to mentally test technologies and identify those that best fit their mission.

[140] Ibid.

[141] Markman et al., "Implications of Counterfactual Structure," 322.

V. COUNTERFACTUAL CASE STUDY AUGMENTED REALITY AND THE 117TH BOSTON MARATHON BOMBING

This chapter will use a counterfactual thought experiment to identify the applicability of augmented reality for law enforcement. The 117th Boston Marathon bombing will be used as the event, and Augmented Reality headgear will be the antecedent in this counterfactual. The purpose of this chapter will be to determine the applicability of the technology by identifying the potential benefits and risks it could have when replaying the bombing incident. However, this thesis will not second-guess the police response, the officer's actions on scene, or the decisions made by the unified command.

A. ASSUMPTIONS

As discussed in Chapter I, there are a few assumptions that must be discussed. This chapter will assume that all law enforcement personnel involved in the incident will be wearing augmented reality headgear similar to Google Glass. Another assumption will be that augmented reality headgear will have all of the capabilities discussed in current literature. These capabilities include: various forms of biometric recognition, both voice and facial; infrared imaging; automated license plate recognition (ALPR); thermal imaging; night vision; mapping; friend-or-foe awareness; live video feeds; digital camera; video recording; and automated voice operating system. Although each of these capabilities are available, not all officers will necessarily use them at the same time. Using a counterfactual process with augmented reality as the antecedent will also alter many laws, policies, and procedures. For example, all individuals entering the event will have to pass by a camera.

B. BACKGROUND

The Boston Marathon bombings occurred on April 15, 2013, the first explosion happening at approximately 2:49 p.m. and the subsequent one only seconds later.[142]

There were approximately 23,000 runners in the 26.2-mile race that moved through eight different towns and cities.[143] There were over 1,000 uniformed police officers and Massachusetts National Guard soldiers assigned to the race.[144] Every year, there are approximately one million spectators along the length of the Boston Marathon course.[145] More than 5,600 runners were still participating in the race when the explosions occurred.[146] Three people were killed, and 260 were wounded, including 16 people who lost their legs.[147] From race day to the apprehension of the suspects, the incident spanned a total of five days.

C. BOSTON MARATHON BOMBING AUGMENTED REALITY

1. Monday, April 15, 2013

As runners and spectators begin to gather prior to the 117th Boston Marathon, each individual passes a police checkpoint where police officers wearing Augmented Reality headgear have been trained to systematically scan every individual at the event (Figure 4). As soon as the headgear collects information, it immediately transfers to the command post where it is stored.

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[142] "Boston Marathon Bombings," A&E Networks, accessed June 7, 2014, http://www.history.com/topics/boston-marathon-bombings.

[143] Boston Athletic Association, "Boston Marathon," accessed June 8, 2014, http://www.baa.org/races/boston-marathon.aspx.

[144] Andrea Estes, Maria Cramer and Shira Springer, "Boston Marathon Security Stayed at High Level," *Boston Globe*, sec. Metro, April 17, 2013.

[145] Boston Athletic Association, "Boston Marathon."

[146] "Boston Marathon Bombings," A&E Networks.

[147] Ibid.

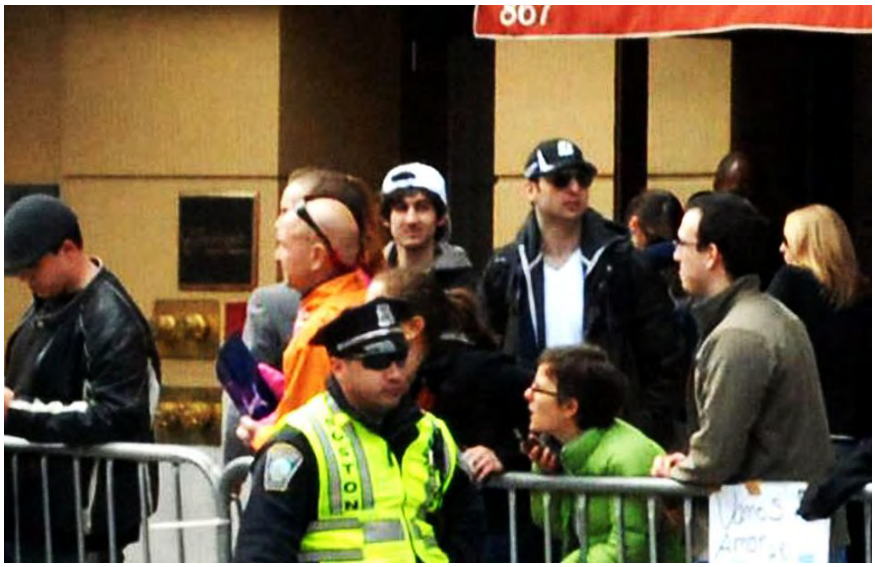

Figure 4. Tsarnaevs on Boylston Street[148]

Because the Central Intelligence Agency (CIA) and FBI placed Tamerlan Tsarnaev on two watch lists, he is immediately identified by the technology.[149] Additionally, Dzhokhar and Tamerlan have files in both the Massachusetts Registry of Motor Vehicles and federal immigration records.[150] Officers on scene immediately become aware of Tamerlan's status with the CIA and FBI so he and his brother, both wearing backpacks, are stopped and interviewed by officers. Both brothers seem nervous when asked about the content in their backpacks. This leads officers to search them, which results in the discovery of the explosive devices. A nearby K-9 officer responds to the scene and the dog detects explosive residue on the backpacks. Officers detain both individuals and clear the area for the bomb squad. Both brothers are arrested without further incident.

[148] Jenna Russell and Thomas Farragher, "102 Hours in Pursuit of Marathon Suspects," *Boston Globe*, April 28, 2013, http://www.bostonglobe.com/metro/2013/04/28/bombreconstruct /VbSZhzHm35yR88EVmVdbDM/story.html.

[149] Eric Schmitt and Michael Schmidt, "Slain Bombing Suspect was Placed on Two Federal Watch Lists in Late 2011," *New York Times*, sec. U.S., 2013.

[150] Russell and Farragher, "102 Hours in Pursuit of Marathon Suspects."

WHAT IF THE SUSPECTS ARE NOT IDENTIFIED ENTERING THE SCENE…

As they walk through the crowds the Tsarnaev brothers avoid any direct contact with law enforcement (Figure 5). They are sure the numerous officers wearing augmented reality headgear have recorded them. They hope wearing baseball hats and walking closer to the buildings will allow them to avoid detection, so far everything is going as planned. Tamerlan places his backpack on the ground near a group of spectators by the finish line. Dzhokhar drops his backpack and begins to walk away, an officer's headgear recognizes a suspicious package on the ground with no one near it. He immediately begins clearing civilians from the area, including an eight-year-old boy, Martin Richard, who is standing just along the fence line (Figure 6).

Figure 5. Tsarnaevs Walking on Boylston Street[151]

[151] Aaron Tang, "Terror at the Marathon," *Boston Globe*, accessed July, 10, 2015 http://www.bostonglobe.com/metro/specials/boston-marathon-explosions.

Figure 6. Second Bomb[152]

Unfortunately, at 2:49 p.m., the first explosive device detonates killing two individuals. Thirteen seconds later, the second device goes off (Figure 7). However, there are far less injuries and one death is prevented as people were moving away from the backpack prior to detonation. Video footage collected at the command post focuses on the area where the second explosion occurred. All individuals standing in the area are identified, including Dzhokhar Tsarnaev, who is wearing a backpack just prior to the one being found by police. A records check identifies Tamerlan Tsarnaev as being on two watch lists. Officers are dispatched to the addresses of both individuals, where both are arrested. Searches of their addresses reveal evidence that link them to the bombing attack that occurred earlier that afternoon at the marathon.

[152] Damien McElroy, "Boston Marathon Bombings: Dzhokhar Tsarnaev 'Pictured Behind Eight-Year-Old Victim,'" *The Telegraph*, April 19, 2013, http://www.telegraph.co.uk/news/worldnews/northamerica/usa/10006491/Boston-marathon-bombings-Dzhokhar-Tsarnaev-pictured-behind-eight-year-old-victim.html.

WHAT IF THE BACKPACK IS NOT FOUND…

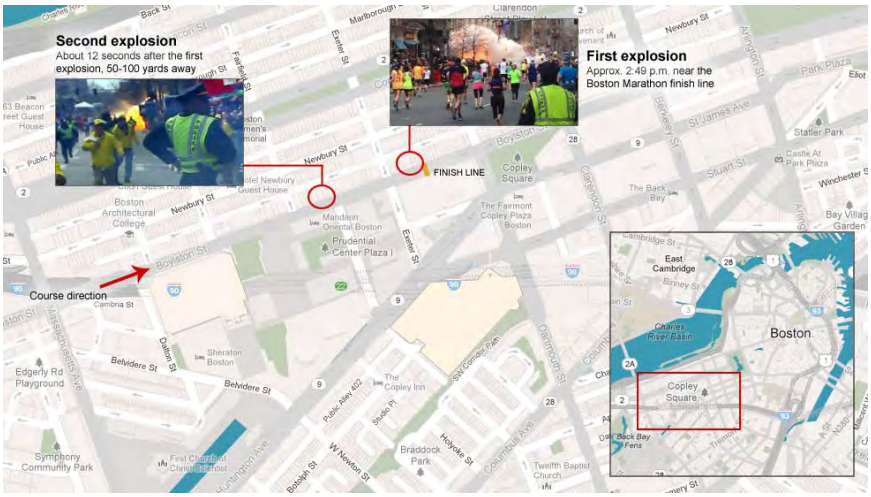

Figure 7. Map of Bombings[153]

Both explosions occur just seconds apart at 2:49 p.m. Commanders viewing the location of all officers begin dispatching officers to establish a 15-block perimeter to conduct counter surveillance on those individuals leaving the area. Commanders also establish checkpoints so anyone leaving the scene will be identified and questioned. As Dzhokhar exits the scene, an officer who was at one of the designated checkpoints recorded him leaving the area (Figure 8).

[153] Google Maps/Sanborn, First Explosion: John Tlumacki/The Boston Globe/Getty Images. Second explosion: Dan Lampariello/Landov, "Map of the Attacks," CNN, April 22, 2013, http://www.cnn.com/interactive/2013/04/us/boston-marathon-terror-attack/.

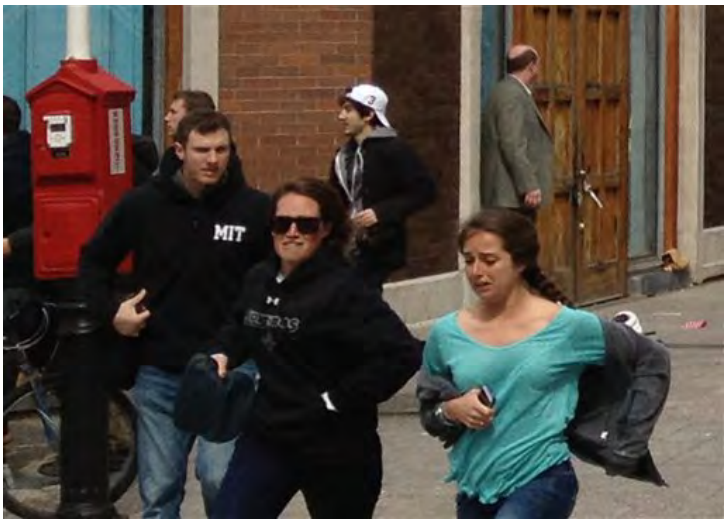

Figure 8. Dzhokhar Tsarnaev Leaving Scene[154]

Meanwhile, law enforcement personnel near the explosions begin assisting the injured (Figure 9). Using their augmented reality headgear, they provide live information to the hospitals reference the victims they are assisting. This provides the hospital with vital information about the incoming patients via the augmented reality headgear, such as who they are, their ages, and the type of injuries sustained. This allows doctors and nurses to provide advice on how to best treat the injuries being seen as well as prepare for incoming patients. Ultimately, this results in fewer amputations and enhances the hospital's overall situational awareness.

[154] Andrew Beaujon, "How the AP Verified Photo of Boston Bombing Suspect Leaving the Scene," Poynter, April 22, 2013, http://www.poynter.org/latest-news/mediawire/211087/how-the-ap-verified-photo-of-boston-bombing-suspect-leaving-scene/; AP photo David Green.

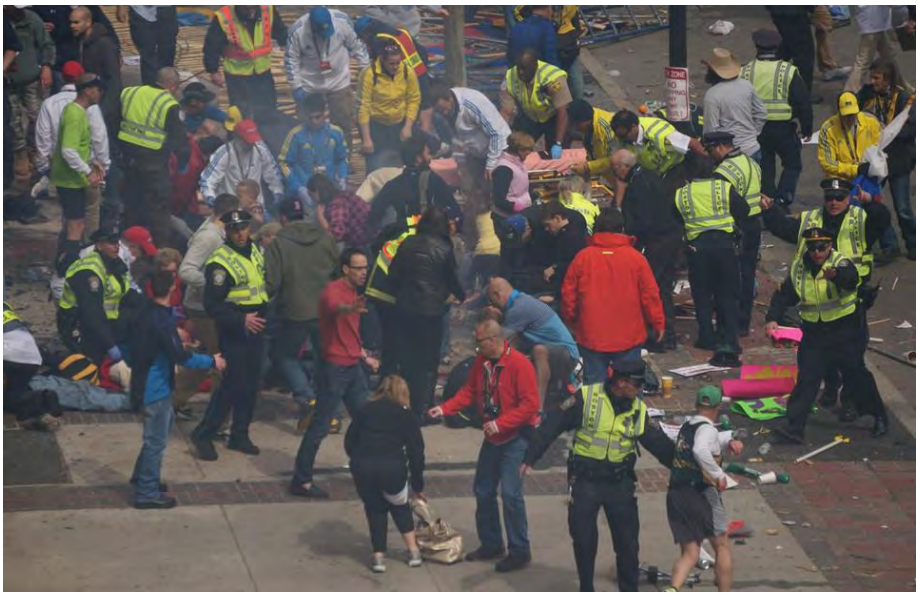

Figure 9. Triaging Victims[155]

As officers and commanders within the command post respond to the incident, a group of analysts begin reviewing footage from the Augmented Reality headgear worn by the officers near the areas of the explosions. The analysts are hoping to identify anyone or anything that appears suspicious. Analysts identify two men walking with backpacks down Boylston Street, who are identified as Dzhokhar and Tamerlan Tsarnaev. Tamerlan has additional advisories because he was on FBI and CIA watch lists. This immediately begins inquiries into the backgrounds of both brothers, which results in them becoming the prime suspects in the bombings. The FBI disseminates flyers to the public, which identify the Tsarnaevs and asks for their assistance in apprehending them (Figure 10).

[155] Tang, "Terror at the Marathon."

Figure 10. Tsarnaev Brothers Wanted[156]

Both suspects are apprehended just a few hours after the FBI announces the identities of the Tsarnaev brothers. Law enforcement searches the residences of the Tsarnaevs and seizes more evidence and uncovering a plot to attack New York City. The information received from the Augmented Reality headgear as well as the collaborative efforts of all involved bring quick closure to this incident. This not only prevents a potential terrorist attack, but it also saves the life of Massachusetts Institute of Technology (MIT) police officer, Sean Collier. Additionally, the shootout in Watertown is avoided, which prevents the injuries of 14 police officers wounded by gunfire.[157] This also stops the manhunt on Friday which shutdown an entire city.

> WHAT IF LAW ENFORCEMENT DOES NOT IDENTIFY THE BROTHERS ON MONDAY…

2. Thursday, April 18, 2013

At approximately 5 p.m. the FBI identifies the Tsarnaev brothers as the suspects from the 117th Boston Marathon bombing. At approximately, 10:30 p.m., the Tsarnaevs approach the vehicle of MIT police officer Sean Collier and kill him. His Augmented Reality headgear records the incident and sends a live video feed to dispatch, this information includes his vital signs. As the Tsarnaevs attempt to steal Officer Collier's

156 "Tsarnaev Brothers Wanted," *Bloomberg Business Week*, accessed July 10, 2014, www.businessweek.com

157 Mark Schone et al., "108 Hours: Inside the Hunt for the Boston Marathon Bombers," *NBC News*, accessed June/13, 2014, http://www.nbcnews.com/storyline/boston-bombing-anniversary/108-hours-inside-hunt-boston-marathon-bombers-n76956

firearm, the Augmented Reality headgear facially recognizes the Tsarnaevs as the suspects. Dispatchers immediately recognize the Tsarnaev brothers and notify all officers in the area that the suspects are the same as identified from the Boston Marathon bombing. Every available officer is dispatched to the area, and although there is a short firefight, both suspects are arrested. This prevents the kidnapping of an individual and the hijacking of a vehicle as well as the subsequent shootout on Laurel Street. It also prevents the manhunt in Watertown that would take place later that evening and into Friday.

WHAT IF THE SUSPECTS ARE GONE WHEN POLICE ARRIVE …

At approximately 11 p.m. on Thursday evening, an individual is carjacked by the Tsarnaevs. The Tsarnaev brothers kidnap the driver of the vehicle, but he eventually escapes and advises the police they are is the suspects from the bombing. As police converge towards the scene, commanders are able to strategically establish a perimeter circling the Tsarnaevs based on officer locations provided by the Augmented Reality headgear. Although a shootout occurs, those officers at the scene are aware of the locations of their fellow officers as seen through their Augmented Reality headgear. Ultimately, both Tsarnaevs are apprehended, Tamerlan is killed and Dzhokhar is arrested (Figure 11). The controlled response by law enforcement prevents a friendly fire situation so no officers are wounded. It also prevents the escape of the Dzhokhar as well as the manhunt in Watertown on Friday.

Figure 11. Tsarnaev Brothers Captured[158]

WHAT IF THE PERIMETER IS NOT SECURE (Figure 12) …

Figure 12. Dzhokhar Tsarnaev at Large[159]

At approximately 1:00 a.m., Tamerlan is killed during a shootout on Laurel Street. Dzhokhar escapes, so police officers establish a perimeter and begin executing a search plan to locate him. The augmented reality headgear provides officers with a grid to search the area as well as a thermal imaging display. Additionally, the technology provides officers who are from other jurisdictions a map of the area. This greatly assists their movements through neighborhoods and residences. One officer is walking through a backyard and the thermal imaging from his headgear shows an individual hiding in a boat

158 Greg Botelho, "Timeline: The Boston Marathon Bombing, Manhunt and Investigation," *CNN*, May 2, 2013, http://www.cnn.com/2013/05/01/justice/boston-marathon-timeline/.

159 Redditian, January 31, 2014, Redditian, http://www.redditian.com/r/AdviceAnimals/1wnovz.

(Figure 13). The officer advises dispatch what he has found and the commanders immediately begin dispatching individuals to the area.

Figure 13. Dzhokhar in Boat[160]

As commanders establish a perimeter, they assign officers to specific areas to prevent a friendly fire situation. Once all officers are in place the suspect is tactically removed from the boat and arrested at 5 a.m. (Figure 14). The quick response by law enforcement personnel allows the city of Watertown to resume its daily life early Friday morning.

Figure 14. Dzhokhar Captured[161]

[160] Michael Walsh, "Dramatic Helicopter Video Using Thermal Imaging Locates Boston Bombing Suspect Dzhokhar Tsarnaev in Boat," *Daily News*, April 20, 2013, http://www.nydailynews.com/news/national/thermal-imaging-aided-bomb-suspect-arrest-article-1.1322811.

VI. COUNTERFACTUAL ANALYSIS

This chapter will analyze four different aspects of the counterfactual thought experiment from the previous chapter. First, it will examine the validity of the scenario based on the criteria established in Chapter I. Second, it will analyze the scenario to determine how Augmented Reality might have affected the outcome of the 117th Boston Marathon bombing and the events that followed. Third, it will identify where the Augmented Reality headgear could have impacted the law enforcement response to the bombing. Finally, the chapter will conclude with an examination of the scenario to determine potential problems with this technology.

A. COUNTERFACTUAL VALIDITY

The scenario was based on an idiographic style of counterfactual analysis in which an easily imagined technology was introduced into a historical event to determine what could have played out differently.[162] In accordance with Belkin and Tetlock's established parameters to verify the validity of counterfactual thought experiments, the validity of the scenario will be examined by the following criteria: clarity, logical consistency or cotenability, and historical consistency.[163] The scenario had clarity as it defined the antecedent, the possession of Augmented Reality headgear worn by all law enforcement personnel during the incident, as well as the consequent. The counterfactual thought experiment successfully examined several areas where the antecedent could have altered or improved the law enforcement response, potentially altering the consequent. Some examples of this were in situational awareness, command and control, life safety, as well as surveillance and detection. The scenario's cotenability was also established. The connecting principles were precise; they were consistent throughout the scenario; and they were consistent with the antecedent and consequent. This was completed by the establishment of a timeline of the actual incident so it followed the events as they

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[161] Russell and Farragher, "102 Hours in Pursuit of Marathon Suspects."

[162] Tetlock and Belkin, *Counterfactual Thought Experiments*.

[163] Ibid.

occurred in the Boston. Therefore, the antecedent used in the counterfactual thought experiment provided the necessary interconnectedness needed. During the scenario, law enforcement used the different capabilities of the Augmented Reality headgear. While today, Augmented Reality capabilities are currently being used individually, they have not all been fully integrated into Augmented Reality headgear. The capabilities of the Augmented Reality headgear used within the scenario are currently being used by different disciplines. For example, fire departments use thermal imaging and SWAT teams use infrared technology in accomplishing their missions. The scenario relied upon the fact that all of the capabilities functioned within the Augmented Reality headgear. This scenario maintained historical consistency throughout the counterfactual. The dates and times of the incident were obtained from multiple data sources. The antecedent, Augmented Reality headgear, was the only change in the rewrite of this incident.

B. COUNTERFACTUAL THOUGHT EXPERIMENT ANALYSIS

When the antecedent was applied to the event, it impacted several points during the incident; it showed opportunities of interrupting the sequence of events. For example, if the bombers were identified on Monday then the events that unfold on Tuesday through Friday might not have happened. The previous chapter identified many areas where Augmented Reality headgear could have been utilized had it been available for the 117th Boston Marathon bombing. Throughout the incident there were several occasions where Augmented Reality headgear could have assisted the law enforcement response and might have affected the incident at different times.

During a response to a major incident, one of the most vital components is situational awareness. Scott Reichenbach states, "Complete, accurate, and up-to-the-minute situational awareness is essential for emergency responders and others who are responsible for controlling complex, dynamic systems and high-risk situations."[164] Basically, he is saying that it is critical to obtain situational awareness in large multifaceted incidents in order to manage and coordinate an emergency response.

[164] Scott Reichenbach, "Situational Awareness: Key to Emergency Response," *Fire Engineering* [Online] 162, no. 3, (2009), http://www.fireengineering.com/articles/print/volume-162/issue-3/features/situational-awareness-key-to-emergency-response.html

Concerning, the 117th Boston Marathon bombing, Reichenbach further states, "Inadequate or completely absent situational awareness is cited as one of the primary factors in accidents attributed to human error."[165] His point is, one of the primary reasons commanders fail during these types of incidents is often due to a lack situational of awareness. This scenario identified several areas where Augmented Reality headgear could have improved situational awareness for the command post. Throughout the pre-incident, incident, and post-incident phases, commanders could have monitored the event in real time through Augmented Reality headgear on field personnel. There were instances during the real event where having situational awareness could have made an impact. In the actual incident, an overwhelming amount of information came from social media, mass media, cell phones, texts, and tips, which in many instances provided misinformation.[166] Ultimately, this both helped and hindered the police response to the incident. Law enforcement requested assistance from the public and private sector to assist with the investigation, which eventually helped them identify the two suspects. Conversely, the flood of information from various sources created false information and accusations against innocent people that often shifted the focus of police. The amount of raw information coming in from almost every method of communication hindered commanders from focusing on the strategic and tactical decisions needed to effectively manage the incident.[167] Having information come from law enforcement personnel trained to identify suspicious activity versus untrained civilians could have provided more useable data. Furthermore, law enforcement personnel on the scene collecting raw information and then vetting it through their chain of command could have provided senior officials with better data to make decisions.

The counterfactual thought experiment identified how Augmented Reality headgear could have improved command and control throughout the incident. Senior

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[165] Ibid.

[166] Herman B. Leonard et al., *Why was Boston Strong? Lesson Learned from the Boston Marathon Bombing*, Harvard Kennedy School, 2014, http://www.hks.harvard.edu/var/ezp_site/storage/fckeditor/file/pdfs/centers-programs/programs/crisis-leadership/.

[167] Ibid.

commanders at the command post could have located and continuously monitored all of their law enforcement resources via the Augmented Reality headgear. Having increased situational awareness and knowing where their assets were located may have allowed commanders to make more informed decisions when deploying officers in the field. As discussed in the scenario, being able to methodically move resources from one area of need to another could have greatly increased the efficiency of the response in Boston. The scenario identified how having command and control of resources could have assisted law enforcement in surveillance, detection, counter surveillance, and crime scene coordination, as well as perimeter security during all phases of the incident.

Throughout the incident, Augmented Reality headgear could have provided increased officer safety. The potential to view the vital signs of each officer during the event would have been of great benefit to the health and safety of law enforcement personnel. If the command post recognized an officer in need of assistance, it could have quickly deployed assets to render aid. Furthermore, the technology could have reduced the number of friendly fire situations that occurred during the incident. On Thursday, April 18, 2013, during the apprehension of both suspects, there was a friendly fire incident that injured 14 officers. On Friday, April 19, 2013, during the capture of the second suspect there was the potential for a second friendly fire incident.

During the pre-incident and incident phases, had law enforcement gathered large amounts of its own photographs and video, it may not have relied so heavily on security cameras from the private sector or data from the public. In fact, if Augmented Reality were actually being used by law enforcement, there would be many additional laws and standard operating procedures governing its use. For example, police officers at the scene would have been taking pictures and videos of every individual attending the event and gathering information from the crowds and not necessarily the runners as most of the public was doing. Law enforcement would have been scanning the area looking for suspicious situations, persons, vehicles, or objects. Additionally, the strategic placement of police checkpoints could have provided a more comprehensive visual record of those within the vicinity of the incident. This information may have provided more videos and photographs that could have assisted in identifying the suspects earlier, which could have

prevented the incidents on the evening of Thursday, April 18, 2013, and the search and capture of Dzhokhar Tsarnaev on Friday, April 19, 2013.

During the scenario, there were several capabilities identified where Augmented Reality technology could have been used to assist law enforcement efforts. They include thermal imaging, infrared technology, and knowledge of building floor plans. All three capabilities could have been used during the clearing of the crime scene, where officers had to clear a 15-block radius and were forced to search and secure all buildings. These capabilities could have also enhanced the law enforcement response during the firefight with the suspects, as well as the search and capture of the second suspect.

As previously discussed, Augmented Reality headgear could have impacted several phases of the 117th Boston Marathon bombing; however, it is questionable whether the technology could have prevented the incident from happening altogether. For instance, private security cameras first recorded the Tsarnaev brothers approximately 12 minutes prior to the explosions, which may not have been enough time for law enforcement to detect them and intervene. If the brothers had been discovered within that 12-minute window, they could have still detonated their explosive devices but possibly in a different area on Boylston Street. Besides, once they split up, it would have been even more difficult to stop both of them. Even if there had been no intervention, the Augmented Reality headgear could have improved the overall response to the incident and prevented some of the subsequent issues that followed the initial bombings.

C. AREAS OF CONCERN

Although this counterfactual analysis has identified the potential uses of Augmented Reality headgear during the various phases of the 117th Boston Marathon bombing, it also revealed several areas of concern. This scenario examined the applicability of an emerging technology for law enforcement. Such experiments rely on much prediction and speculation. One must predict how things could have happened if the technology were used during the incident and anticipate other casual influences. It is purely speculation that Augmented Reality headgear would have had any impact had it been available to police. As with any counterfactual thought experiment, there are many

factors that could have influenced the outcome of an incident. This is especially true in dynamic situations where human emotions are involved. For example, when dispatch requested units respond to Laurel Street for the shootout with the Tsarnaevs, officers both on and off duty in both work and personal vehicles raced to the scene. Even with Augmented Reality headgear, they may have still gotten into friendly fire situations because they had become so emotionally involved. They may not have listened to the command post or may have ignored information being received via their Augmented Reality headgear.

Therefore, it is impossible to say with complete certainty that things would have happened the way they were presented. When conducting counterfactual thought experiments, it is important to recognize the biases of the individual conducting the scenario because he or she will most likely rely upon their experiences and knowledge. Likewise, individuals cannot predict the future, so this technology may never achieve what current literature states it can.

Although this scenario assumed Augmented Reality headgear had all available capabilities as discussed in current literature. Technologies like, Augmented Reality headgear, often rely on communication systems, databases, and internet connectivity to function properly. It is important to realize, in large-scale incidents, some of the capabilities discussed could have failed. This could have happened due to a loss of power in the device, an overload on communication systems, or failure of other technical systems. These problems could have created a stand-alone device where only some of the components may have been operational. This scenario also assumed the Augmented Reality headgear would have had access to variety of databases needed to identify biometric data, license plates, and individuals. Unfortunately, it is difficult to share all of this information and have it connected to a single device. This counterfactual thought experiment successfully identified some key problems that must be considered with this emerging technology.

The scenario also identified problems with privacy, civil rights, and funding issues. The use of this type of technology could bring many privacy issues for the public and officers who feel they are being surveilled unnecessarily. Law enforcement agencies

could face mistrust and legal issues within the community if the public viewed this as a violation of their civil liberties. Additionally, not all agencies would have the funding for this technology, nor would they all purchase it from the same vendor if it were available. This could create interoperability issues that may not allow different systems to talk to each other.

In conducting this scenario, this writer also has biases. Based on the author's training and experience, he made assumptions that all officers during the incident would act with due diligence and would respond appropriately. He also assumed all officers would have the same level of equipment and that it would all be functioning properly. However, he did realize not all agencies acquire the same training, keep their equipment in working order, and respond in the same way the author was trained.

D. ANALYSIS OF COUNTERFACTUALS TO IDENTIFY EMERGING TECHNOLOGIES

Typically, it is difficult for law enforcement agencies to identify the applicability of emerging technologies. Some select agencies have the opportunity to participate in the research and design of a project or new technology, while others may have a special unit within their agency that examines future technologies or tests technologies already created for them. Most of the time, agencies purchase a piece of equipment already introduced into society by another organization. However, these processes often do not allow police organizations to recognize potential issues these technologies bring to their communities. Using a counterfactual thought experiment does provide agencies with another tool to determine the applicability of emerging technologies. Conducting counterfactual thought experiments allows police agencies to identify both the positive impacts a technology might have on their communities as well as the potential issues they might bring. Counterfactuals may provide law enforcement organizations a new method for determining the applicability of emerging technologies and avoiding the consequences often associated with them.

The next chapter will provide recommendations based on the analysis from this chapter. It will also describe a step-by-step process to conduct a counterfactual thought experiment as well as identify areas for further research.

VII. RECOMMENDATIONS

This chapter will provide recommendations for law enforcement to implement counterfactual thought processes for identifying emerging technologies. The recommendations will be based upon the analysis and discussions from previous chapters. Additionally, the chapter will suggest areas for further research. It will also propose alternative methods of conducting counterfactual analyses.

A. OVERVIEW

Law enforcement agencies often have issues identifying the applicability of technologies that could assist them in policing their communities. This is due to rapid advancements in technology, which have created a tremendous amount of products and services requiring more trained personnel and additional responsibilities for commanders.[168] According to Darren Stewart, "The volume of options and opportunities to further incorporate new technology into police work brings also the need to thoroughly investigate, develop policy, test drive, train and, of course, identify financing."[169] In other words, Stewart believes that due to the overwhelming number of products that law enforcement must choose from, it requires agencies to complete several additional processes in order to acquire them. Stewart further states, "Law Enforcement's slow response to incorporating new technology to combat criminal activity needs to be examined. Such a significant gap between technologies introduction and acquisition provides the savvy criminal with a clear advantage."[170] Basically, Stewart is saying the inability of law enforcement to quickly obtain new technologies potentially benefits criminals who may already be using more advanced tools to commit crime. It is important for police to close the technological gap and allow law enforcement to stay ahead of the criminal element.

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[168] Darren Stewart, "Chasing Technology: Law Enforcement's Friend or Foe?" *Two Cultures, International Journal of Technology, Humanities, and Human Security* 1, no. 1 (2012 winter): 4–8.

[169] Ibid.

[170] Ibid.

B. CONDUCTING A COUNTERFACTUAL THOUGHT EXPERIMENT

The steps for conducting counterfactual scenarios to detect the relevancy of technologies is a fairly simple process that can be used by any police organization. Either one person or a group of individuals can complete the process. Agencies may also consider bringing in key stakeholders within the community to assist with the process. The examination of an emerging technology from as many angles a possible might assist in identifying all of the potential risks and benefits the technology may have when implemented in society. In order to construct a counterfactual thought experiment the following steps are recommended.

First, police organizations must have a strategic plan that addresses the identification and adoption of emerging technologies. Agency leaders have the responsibility to ensure they are prepared to effectively protect and serve their personnel and communities. Furthermore, it is their obligation to look down the road to identify the most useful and appropriate technologies being created by the various research and development companies and laboratories. There are many technology magazines, blogs, and websites that address emerging technologies such as *Popular Science, Popular Mechanics, Wired,* policemag.com, policechiefmagazine.org or policeone.com. More importantly, there are research and development programs, such as the Defense Advanced Research Projects Agency (DARPA), Office of Naval Research (ONR), Army Research Laboratory (ARL), and University laboratories, that could provide information on which technologies are on the horizon or currently being developed.[171] Additionally, police departments could take the initiative to contact the aforementioned sources and ask to be placed on distribution lists, or they can subscribe to the publications produced by them. Collaboration with other police agencies as well as attending conferences that address new technologies could assist in recognizing a technology that may benefit a department in the future.

An organization must identify an emerging technology that is being discussed but may not be operational for 10 to 20 years; however, an agency could choose a new

[171] Jarrett, "Transition of Advanced Technology."

technology that has the potential to be functional within five to 10 years. This technology should address the gap within the agency, enhance the safety of the community or its officers, or could improve the efficiency of the department. Depending on the needs of the organization, this technology could be a very simple device that has one primary function, such as a less lethal weapon, or it could be a very dynamic technology that has multiple applications like Augmented Reality headgear. Once an organization has identified a particular technology, it should obtain as much information about it as possible. Having a comprehensive knowledge about the technology will allow it to conduct the counterfactual thought experiment more thoroughly. Understanding the various nuances of the technology could allow an agency to identify more areas of applicability and recognize risks it might have otherwise not predicted.

The second step is selecting an incident or event that has some applicability to the identified technology. For example, if a police agency has identified a less lethal technology, it would be ideal to have a situation that involves lethal force. If an organization is considering some type of surveillance technology then the event selected should entail some form of surveillance being conducted by officers. This does not have to be a large-scale incident like the 117th Boston Marathon bombing, but it should be a dynamic event that provides more opportunities to test the technology within the scenario. However, an organization could also run the technology through several smaller scale incidents to recognize its relevance. The identification of a variety of methods to apply the technology may give the department a better idea of the impacts it may have on its agency and society. The law enforcement agency does not have to select incidents that occurred within its department; analysts can use events that happened in other jurisdictions if the incidents are more applicable to the technology's potential capabilities. This could provide a more comprehensive evaluation.

The 117th Boston Marathon bombing was chosen for this thesis because the technology, Augmented Reality, had many potential applications that might have been useful and it occurred within the past year. The key factors for selecting the 117th Boston Marathon bombing was it spanned almost five days, law enforcement personnel performed multiple tasks, and events took place in multiple jurisdictions. There were

many areas of the event where Augmented Reality may have affected the police response. Examples of these were officer safety, command and control, crime scene processing, interview and interrogation, surveillance and detection, as well as situational awareness. However, selecting an incident as large as the 117th Boston Marathon Bombing requires the analyst to conduct more research about the incident, versus a smaller scale incident such as a homicide within a resident where there is much less information. For example, the incident in Boston affected all levels of government, over 30 different law enforcement agencies, as well as multiple jurisdictions. On the other hand, a homicide investigation may have affected one level of government, one agency, and might have only happened in one location. If the 117th Boston Marathon bombing not been used and a smaller less dynamic incident had been chosen, it would have been more difficult to test the multiple capabilities Augmented Reality could perform. Therefore, multiple scenarios would have had to been used to determine its applicability.

Another reason the 117th Boston Marathon bombing was chosen over smaller scale incidents was because of available information about the event itself. It may become difficult to conduct a thorough counterfactual analysis if the data needed to conduct the scenario is not available. In large-scale incidents that involve multiple agencies and different levels of government, gathering information from them can often be problematic. The lack of available information could be due to sensitive or restricted information that cannot be released, the incident might still be in the judicial process, or an agency may not be willing to share its detailed reports. However, this process can still be used even if the investigator did not have access to all of the information from the actual agencies involved in the incident. The counterfactual thought experiment in this thesis was conducted without the use any police reports or actual incident reports from the event. Several after action reports from external sources were located, but none directly from the agencies themselves. The benefit of a high profile incident is the amount of open source information available, which can be used when incident reports are not available.

Prior to beginning the scenario, it is important to state any assumptions being made about the scenario. This allows those who will eventually conduct the analysis to

understand the parameters used during the process. There may be policies, procedures, or laws that are not currently in place but would need to be to successfully conduct a thoughtful scenario. Therefore, it is very important to identify all of the assumptions being made so the reader knows how and why things happened as they did in the scenario.

The third phase of this process is to rerun the selected incident with the chosen technology to determine its applicability. When conducting a counterfactual thought experiment, it is essential to change as few variables as possible. In this scenario, Augmented Reality headgear was the only variable that was introduced. Each decision or action that alters the actual incident has the potential to create a ripple effect that could reduce the plausibility of the rewrite.

Knowing where to insert the technology during the incident is vital to the success of the scenario. When researching an incident, key decision points must be identified to determine where the new technology could have changed the response of the police agency, which ultimately might have altered the incident. With a large scale and dynamic incident like the 117th Boston Marathon bombing, there were several areas where the law enforcement mission affected all stages of the incident. Normally, the assignments and duties of personnel at the scene of an incident are outlined in the operations plan so if something does occur they know their responsibilities. For example, law enforcement agencies normally have pre event responsibilities, such as scene security and crowd control. During this phase of an incident, officers are strategically placed to identify any suspicious individuals or to assist with any problems that arise. This provided an opportunity for law enforcement personnel to potentially use the augmented reality to assist them in performing their duties. By reviewing operations plans and researching the incident, analysts will recognize key transitions within the incident and can utilize them to rerun the event.

If an operation plan is not available, reading hot washes, after action reports, and lessons learned documents might assist in locating key decision points where the technology could have improved the response to the original incident. The analysis of these documents will assist in identifying gaps within the response of the law

enforcement agency. Law enforcement commanders are often aware of their deficiencies and can pinpoint key decision areas that need attention. Often times, their experience alone can identify issues that need to be addressed. Typically, when police agencies identify gaps, organizations will address those deficiencies by training their personnel to increase their capabilities. Then the organization conducts exercises to test the capabilities of the department and its personnel to determine if the gap was addressed. Unfortunately, when a technological gap is identified, agencies use the same training and exercise cycles to address the issue. They retrain personnel to enhance their use with the technology and then exercise them to see if the issue was resolved. If the technological gap is due to outdated equipment, agencies contact vendors to assist them in selecting a technology to close that gap. However, this replacement technology has often been in use for a period of time and might soon be outdated. Counterfactual thought experiments provide an opportunity for law enforcement agencies to conduct a simple process to identify the applicability of emerging technologies and determine how the technology could improve its response. Departments may rerun the incident with the emerging technology to examine those decision points to determine if the emerging technology could have closed those gaps. Rather than relying upon a retailer to present off-the-shelf technologies that may soon be outdated or may only meet part of its needs, it can use counterfactuals to potentially identify emerging technologies. Throughout the scenario, it is important to continually ask “what if” questions to recognize the potential positive and/or negative impacts the technology might have had if it were used during the incident. This allows analysts to potentially identify areas that were not originally identified but may have some additional applicability.

The fourth step is to conduct an analysis of the counterfactual thought experiment. In order to determine how the technology could have changed the incident, it is important to identify the key areas where the technology could have assisted the agency in accomplishing its mission. When conducting the analysis, analysts need to consider the previously identified gaps or issues the technology could resolve. This could help analysts determine if rerunning the incident resolved any of the issues previously mentioned. It is critical to discuss potential changes in policies, procedures, and laws that

may be needed to effectively implement the technology. In the analysis, it is also essential to discuss any remaining concerns that were discovered during the counterfactual process. These could be negative impacts not previously identified or additional benefits that were recognized that had not previously been discussed.

Finally, the last step is to provide recommendations based on the analysis. The scenario should be reviewed to identify situations where the technology could have impacted the incident. If any negative impacts are identified, then the organization could examine alternatives to resolve any potential issues prior to procurement. This may allow police departments to meet with key stakeholders, such as the ACLU or other privacy advocacy groups, to create plans, guidelines, or laws to ensure that the negative impacts were addressed. Furthermore, police agencies could contact the vendors and work with them to resolve issues with the product. This could also provide an opportunity for an agency to work with the vendor on the development of future technologies.

After reading the above steps, one might wonder why go through such a lengthy process when agencies can brainstorm, mind map, or simply discuss what might have been? This process provides an opportunity for law enforcement agencies to systematically identify the potential risks and benefits of emerging technologies by examining their use in past incidents. History often repeats itself, so using past incidents as future indicators provides a solid foundation to conduct counterfactuals. Furthermore, this process provides a sequence of events that control how the technology could be implemented into the event. The historical incident provides fixed variables based on the real event, which provides a structure to test the technology. It also shows how decisions could create a ripple effect within the incident and could have changed outcomes that could not be imagined in fictional incidents. Once the thought experiment has been concluded, it provides a basis for analysis and recommendations, thus, adding credibility to the process.

C. NEXT STEPS

Once the police agency has identified the applicability of the technology, there are other factors that must be considered if the organization wants to acquire Augmented Reality technology in the future. It must examine how this technology would be implemented into its department. It is important to begin looking at issues such as funding, training, as well as creating the necessary policies, procedures, and laws, to implement this new technology.

D. AREAS FOR FURTHER RESEARCH

Using a process to identify technologies could be used in many fields such as automotive, agriculture, emergency medical services, fire, homeland security, and medical. Almost every field uses some type of technology, so this process could be applicable to all of them. For example, fire departments need equipment that will identify specific chemicals when they respond to hazardous materials incidents, so they must rely on technology to safely perform their duties. Counterfactuals could assist fire departments in identifying the applicability of chemical detectors that might make their work safer. This process could be examined by other disciplines to potentially improve how they adopt technologies. Some of the various fields may not have the same issues as law enforcement have with identifying the applicability of emerging technologies because they might have research and design divisions or work with manufacturers to create new technologies. However, using counterfactuals to recognize the potential impacts emerging technologies could have on their organization could provide value.

As previously discussed, law enforcement organizations are inefficient at recognizing and adopting new technologies. Although police organizations are often slow to adopt new technologies, their agencies rely on technology to accomplish their missions. Therefore, law enforcement departments might need to examine the qualifications of their workforce. With the rapid advancement of technologies and the impacts they have on police agencies it is essential to have a workforce with proficiency in information technology. A more tech savvy workforce could provide many benefits to the organization.

The use of counterfactual thought experiments to identify the applicability of emerging technologies for law enforcement creates an opportunity for current technology to assist with this process. Instead of using a group of individuals to work through the counterfactual process, an algorithm could be created where the selected emerging technology and incident are entered into a computer program that calculates its applicability. Based on the data and facts of the actual incident, it might have the ability to provide percentages of what could have changed had the technology been implemented. This could potentially eliminate much of the work personnel would be required to accomplish.

The application of counterfactual practices may also assist law enforcement during the procurement phase. By running scenario based thought experiments and identifying the risks and benefits, organizations might specify the exact capabilities they want in a particular technology during the request for proposals (RFPs) process. Instead of vendors telling a police agency what its product can do for them, the department can advise the vendor what it needs from the vendor.

E. CONCLUSION

The impact technologies will have on law enforcement in the future could dictate how effectively they accomplish their missions. In order to keep up with the rapid pace of technology police must identify a process to assist them in identifying emerging technologies for their departments. Using counterfactual thought experiments could help law enforcement determine the impacts technologies may have on their organizations. Thus, allowing them to acquire and implement technology into society potentially avoiding the risks and maximizing the benefits the technology brings.

Based on the analysis of the scenario, counterfactuals might not have prevented the 117th Boston Marathon bombing but could have made significant impacts. Counterfactual thought experiments provide law enforcement another tool to identify the applicability of emerging technologies for their organizations. By following the aforementioned process, police agencies could successfully implement technologies and close the gaps they often create between themselves and the criminal element.

This thesis recommends using a counterfactual thought process, which has existed for centuries, to provide an effectively low-cost process to help law enforcement identify future technologies. This methodology will not only assist police in preserving its ability to effectively identify and implement new technologies, but it will allow it to maximize new technologies to remain ahead of the criminal element.

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